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Farm-Level Effects of Soil Conservation and Commodity Policy Alternatives: Model and Data Documentation

John D. Sutton

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ABSTRACT

This report documents a profit-maximizing linear programming (LP) model of a farm typical of a major corn-soybean producing area in the Southern Michigan-Northern Indiana Drift Plain. The model is structured to help analyze after-tax income and erosion effects of soil conservation and commodity program options on cash-grain farms having various land, labor, and financial resources.

Keywords: Soil conservation policies, commodity policies, erosion, linear programming.

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INTRODUCTION

A variety of forces shape development of our Nation's agricultural policy, including pressure to reduce the Federal budget deficit and the contribution of USDA programs to that deficit; public awareness over the continued high level of soil erosion from agriculture and concern that traditional commodity programs contribute to soil erosion; and, pressure to respond to the severe financial straits in which many farmers find themselves.

The Natural Resource Economics Division (NRED) of the Economic Research Service generates information helpful to farm policy discussions by analyzing commodity and conservation policy options with a variety of mathematical models. The NRE-CARD National Hybrid model is important in this regard. It links an interregional agricultural linear programming model of the United States (105 producing areas and 28 market regions covering major crop production) with a cross-commodity econometric model (8). 1/ The model generally has the ability to evaluate national and interregional (1) consequences of commodity market policies on environmental change and resource use; (2) impacts of changes in production technology, resource supplies, and environmental restraints on both commodity and factor markets; and (3) interaction between market activities and resource use.

This project provides NRED with an analytical tool that (1) can analyze after-tax income and soil erosion effects at the farm level of various conservation and commodity program proposals; and (2) can be readily adapted to various U.S. regions experiencing severe erosion problems. The linear programming (LP) model presented in this paper represents an attempt to meet these two objectives.

In order to meet the first objective, an LP model of a cash grain farm typical of an important producing area of Major Land Resource Area (MLRA) 98, Southern Michigan and Northern Indiana Drift Plain, was constructed. Activities and resource restraints of the LP model allow users to determine

1/ Underscored numerals in parentheses refer to items in the references section.

for farms with different liability-asset structures and levels of off-farm income the effect of alternative policies on:

- o Income.
- o Erosion (sheet and rill and wind erosion).
- o Area in specific crops, in specific types of conservation tillages, in specific conservation support practices.
- o Labor use during preplanting, planting, cultivation, and harvesting periods.
- o Income deficiency payments for crops in the Federal commodity program.
- o Loss in long-term crop yields due to excessive erosion.

Alternative policies to be analyzed include such options as:

- o Producer subsidies for soil conserving crops, conservation practices, or reduced tillages. Penalties for production activities that result in excessive erosion.
- o Exogenously set limits on the amount of soil loss acceptable on individual farm fields or for the farm as a whole.
- o Limits on total payments for soil conservation, or for commodity program participation.
- o Alternative levels for target prices, income deficiency payment rates, acreage reduction requirements, acres diverted for which payments are made, and the payment rate. Readers interested in the types of policy analyses of interest on the MLRA 98 farm in mid-1985 are also referred to Sutton (20).

To meet the second objective, this model, although initially developed for conditions in southern Michigan, is to be modified and applied to important producing areas of other MLRAs experiencing severe erosion. This should provide national policymakers with additional information about farmers' willingness to participate in alternative programs; implications for direct Federal expenditures of various price and income support and soil conservation policies; and effects on soil erosion and on production of program crops. Careful study of impacts on different farms in different MLRAs also has the potential to provide a type of farm-level verification of results of the NRE-CARD National Hybrid Model and assist in developing policy options to test in the national model.

To facilitate meeting this second objective, we placed emphasis on developing a flexible model that could be readily modified to different conditions. Similarly, by keeping model size and data requirements small, we have attempted to keep the tasks of developing new data sets, updating and/or revising coefficients in existing models, and interpreting the

policy impacts of the several farm models to be more manageable. Finally, we placed heavy reliance on using, without modification, existing USDA and Michigan State data sets regarding crop production budgets, erosion, and whole farm expenses.

THE FARM IN MAJOR LAND RESOURCE AREA 98

The procedure to develop a farm description involved several steps:

- Determine availability of reliable crop production budgets.
- Enlist cooperation of State-level staff of the Soil Conservation Service (SCS), the Agricultural Stabilization and Conservation Service (ASCS), and the Cooperative Extension Service (CES) to select an important producing area of the Major Land Resource Area (MLRA).
- Work with county staff to select from existing crop rotation-tillage-conservation practice budgets those which would be on the representative cash grain farm. Develop data relating to expenses and assets of the whole farm.

Major Land Resource Area 98

MLRA 98, the Southern Michigan and Northern Indiana Drift Plain, has 75 percent of the land in farms and over half is cropped (15). Corn, other feed grains, and hay for dairy cattle and other livestock are the major crops. Soft winter wheat and dry beans are important cash crops in the upper two-thirds of the MLRA. Less than 10 percent of the MLRA is in permanent pasture. In much of the area, precipitation is adequate for crops, but conserving moisture in coarse textured soils is a major management concern. Ground water is abundant. Most soils are Udalfs or Aqualfs. They are deep, medium textured, and moderately coarse textured. In the south, well drained Haplidalfs and somewhat poorly drained Ochraqualfs are dominant. These soils have a mesic temperature regime, an udic or aquic moisture regime, and mixed mineralogy.

USDA agencies in Michigan, primarily SCS and ERS, developed an extensive and automated set of crop production budgets for the southern part of MLRA 98 in 1983-1984 as part of the St. Joseph River Basin Study (17). Staff in the State USDA offices identified Branch County as an area that had been targeted for priority Federal assistance to reduce water and wind erosion. On the northern edge of the Corn Belt, Branch County is more than 60 percent cropland. Its chief cash crops are corn for grain (114,000 acres), soybeans (44,000 acres), and wheat (21,000 acres). Hayland and pasture account for 37,000 acres.

Both sheet and rill erosion and wind erosion are problems. Some 37 percent of cultivated cropland erodes at an annual average rate of 6.4 tons/acre,

a rate between T and 2T. 2/ Eleven percent erodes at an average rate of 14.1 tons/acre, a rate greater than 2T. Fox, Locke, Oshtemo, and Hillsdale-Riddles soils are the most extensive soils.

Farm Description

USDA county staff generously cooperated in developing the parameters of a cash grain farm that would be representative of this section of the MLRA. 3/ They selected crop production activities from those developed in 1983 for the St. Joseph River Basin Study (17). The farm description is as follows:

Crop rotations	: corn-corn-corn (CCC)
	: corn-corn-soybeans (CCB)
	: corn-soybeans (CB)
	: corn-corn-soybeans-winter wheat with cover (CCBWX)
	: corn-corn-oats-5 years of alfalfa (CCOA5)
Tillages 4/	: conventional (moldboard plow)
	: chisel plow with light disking
	: plow plant (moldboard plow without disking)
	: no till
Practices	: plowing straight up and down the hill
	: grassed waterways
	: diversions with contouring
	: vegetated critical areas
Cropland	: 700 acres of harvested cropland
	: 7 fields represented by 1 soil per field
	-- Fox (4% slope), 75 acres, sandy loam
	-- Fox (8%), 36 acres, sandy loam
	-- Hillsdale-Riddles (6%), 160 acres, fine sandy loam
	-- Locke (4%), 200 acres, fine sandy loam
	-- Ormas (4%), 110 acres, loamy sand
	-- Oshtemo (4%), 70 acres, sandy loam
	-- Oshtemo (18%), 49 acres, sandy loam
	: irrigation only is used on Ormas, Oshtemo (4%), Fox, and Hillsdale-Riddles soils

2/ "T is the maximum level of erosion that will permit a high level of crop productivity to be sustained economically and indefinitely" (15).

3/ John Barclay (SCS), John Sarnow (ASCS), and Ray Fast (Extension), all in Coldwater, Mich.

4/ Chisel plow and no till are considered conservation tillage systems in the terminology of the data source. Such a system allows only noninversion tillage operations. Federal cost-sharing is permitted only if 3,000 lbs./acre or more of residue is on the surface at time of planting. SCS is considering changing its criterion for conservation tillage to simply be at least one-third of the surface of any cultivated acre be covered with plant residue.

: Due to differences in soils, the conservation practices and rotations are also specified by field. All four tillages are possible on every field. Crop production practice combinations are shown in table 1.

Tenure : one owner

Labor : two full-time operators

Off-farm income: a nominal amount of ordinary income

Commodity program : The farm is assumed to always be in the feed grain (corn) and wheat programs; the farmer always chooses to default on the commodity loan, thus delivering corn and wheat production to the Commodity Credit Corporation as permitted under nonrecourse provisions of the program. Total commodity program payments are limited to $50,000 per person. 5/

THE LINEAR PROGRAMMING MODEL

A flexible, farm-level LP model was built that could be directly used or easily modified for farms in other critically eroding MLRAs. The model maximizes after-tax farm income subject to a simultaneous system of linear resource constraints. 6/ The mathematical expression of the model is now presented followed by a sample tableau of the LP matrix, and then a full documentation of the purpose and coefficient derivation procedure for each row and column. Symbols used in the equations below appear immediately after the equations.

5/ It is also possible to take the farm entirely out of the commodity program simply by using market prices instead of loan rates, eliminating income deficiency payments (target prices less loan rates), and eliminating any acreage reduction or set-asides due to the program. Net income, cropping pattern, and erosion solutions of the LP can then be compared to solutions for the farm wholly in the program. While the LP can help analyze these either-or situations, it can do little more to help analyze whether it is more profitable to be in or out of the program. For example, in the real world, a farmer may enter the feed grain and wheat programs in December and receive a partial income deficiency payment. Then at any time up to and including harvest, that farmer can withdraw from either program as actual or expected market prices change, paying back whatever CCC funds had been received plus interest. The model does not handle these types of farm-level decisions.

6/ A discussion of the conceptual basis for LP and its applications is available in many sources, for example (2). Types of analyses and analytical results for which this model is suitable may be found in (20).

Table 1--Crop production practices, MLRA 98 representative farm

Soil name	Rotations 1/	Conservation support practices 1/
Ormas	CCC, CCB, CB	Up/down; veg. critical area
Oshtemo (4%)	CCC, CCB, CB	Up/down; veg. critical area
Locke 2/	CCC, CCB, CB, CCBWx	Up/down
Fox (4%)	CCC, CCB, CB	Up/down; waterways; veg. critical area
Hillsdale-Riddle	CCC, CCB, CB	Up/down; waterways; veg. critical area
Fox (8%)	CCC, CCB, CB, CCOA5	Up/down
Oshtemo (18%) 3/	CCC, CCB, CB, CCOA5	Up/down

1/ See text for code explanations.
2/ A portion is in the acreage reduction program for wheat.
3/ All of the field is in the acreage reduction program for corn. These rotations are available and only used for noncommodity farm runs.

Mathematical Expression

Objective Function

$$\text{MAX } Z = \sum_a CS_a + \sum_a CP_a + S + E - \sum_a PC - W - M - N \quad \text{7/} \qquad 1.0$$

(Maximize the difference between (1) crop sales revenue, Federal commodity program payments, Federal soil conservation subsidies, and off-farm ordinary income; and (2) cash production costs, soil depletion costs, nonproduction costs less personal Federal income tax exemptions, and Federal and State income taxes.)

Where

$$CS_a = P_a \sum_b \sum_c \sum_d \sum_e \sum_g X_{abcdeg}\, Y_{abcdeg} \qquad 1.3$$

(Crop sales revenue = crop market price times acres harvested times yield.)

$$CP_a = D_a \sum_b \sum_c \sum_d \sum_e \sum_g X_{abcdeg}\, Y_{abcdeg} + \sum_a A_a XF_a \bar{Y}_a \qquad 1.4$$

(Federal commodity program payments = income deficiency payment for program crops times yield plus paid diversion payment.)

7/ The objective function is actually composed of two simultaneous equations that operate to maximize after-tax income. By name in the matrix, they are YACTEQ (income accounting equality), and TXY (taxable cash income). Refer to the sample tableau.

$$YACTEQ = \sum_a CS_a + \sum_a CP_a + S + E - \sum_a PC - W - K - L \qquad 1.1$$

(The purpose of YACTEQ is to account for all ordinary cash income and tax deductible expenses and to select tax payment activities. The latter are in TXY. YACTEQ = sales revenue plus commodity program payments plus conservation subsidies plus off-farm income less production and cover establishment costs less soil depletion costs less other farm costs less taxable income.)

$$TXY = \sum_a CS_a + \sum_a CP_a + S + E - \sum_a PC - W - M - N + T \qquad 1.2$$

(The purpose of TXY is to account for all cash ordinary income, costs, and taxes and to transfer the residual, T, to the objective function OBJ. Variables are the same as those in the YACTEQ equation except for M which is K less personal income tax exemptions, N which is the tax bill, and T which is the residual transferred to OBJ.)

$$S \overset{8/}{=} +(-) \sum_f R_f \sum_a \sum_b \sum_c \sum_d \sum_e \sum_g X_{abcdefg} +(-) \sum_b TS_b \sum_a \sum_c \sum_d \sum_e \sum_f \sum_g X_{abcdefg}$$

$$+(-) \sum_c V_c \sum_a \sum_b \sum_d \sum_e \sum_f \sum_g X_{abcdefg} \qquad 1.5$$

(Federal soil conservation subsidies = subsidies (penalties) for production activities that produce erosion at different levels f plus (minus) subsidies (penalties) for reduced tillages plus (minus) subsidies (penalties) for conservation support practices.)

$$PC = \sum_b \sum_c \sum_d \sum_e \sum_f \sum_g C_{abcdefg} X_{abcdefg} + \sum_a B_a XF_a \qquad 1.6$$

(Total production costs = crop production costs plus cover establishment costs for diversion acres.)

$$W = \sum_b \sum_c \sum_d \sum_e \sum_f \sum_g G_{abcdefg} X_{abcdefg} \qquad 1.7$$

(Soil depletion costs = cost/acre of erosion at different levels f times acreage.)

$$N = U_1 L_{i-1} I_{i-1} + U_2 L_i I_i \qquad 1.8$$

$$\text{with } U_1 + U_2 = 1.0 \qquad 1.9$$

$$\text{and } L_{i-1} \leq L \leq L_i \qquad 1.10$$

(Total Federal plus State ordinary income tax bill N is the sum of taxes levied--marginal tax rate I times taxable income level L--on incomes i-1 and i.)

Subject to:

Acreage Constraints

$$\sum_a \sum_b \sum_c \sum_d \sum_f \sum_g X_{abcdefg} \leq F_e \qquad 1.11$$

(Acres in crop production cannot exceed field area.)

$$\sum_b \sum_c \sum_d \sum_e \sum_f \sum_g X_{bcdefg} \leq CMAX_a \qquad 1.12$$

(Acres of commodity program crops are limited to their base acreage less diversion set-aside requirements.)

8/ Subsidies have a + sign, penalties a - sign.

$$\sum_b \sum_c \sum_d \sum_e X_{abcdefg} \geq CMIN_a \qquad 1.13$$

(Acres of crop (a) may not be less than specified.)

$$\sum_a \sum_b \sum_c \sum_d \sum_e \sum_f \sum_g CR_a X_{abcdefg} = 0 \qquad 1.14$$

(Crops are forced into specified rotations.)

Labor Constraints

$$\sum_a \sum_b \sum_c \sum_d \sum_e \sum_f \sum_g H_{abcdefg} X_{abcdefg} + \sum_a \sum_e H_{ae} XF_{ae} \leq J_h \qquad 1.15$$

(Field hours used during a period h for production and cover establishment are less than the amount available.)

Program Constraints

$$\sum_e XF_{ae} \leq SA_a \qquad 1.16$$

(Set-aside diversion may not exceed a specified area.)

$$CP \leq COMMAX \qquad 1.17$$

(Commodity program payments to one person are limited.)

$$S \leq CNVMAX \qquad 1.18$$

(Soil conservation subsidies to one farm are limited.)

$$\sum_a \sum_c \sum_d \sum_e TS_b X_{abcde} \leq TSMAX \qquad 1.19$$

(Subsidies to one farm for tillages are limited.)

$$\sum_a \sum_c \sum_d \sum_e \sum_f \sum_g X_{abcdefg} \geq RTMIN_b \qquad 1.20$$

(Reduced tillage areas may not fall below specified minimum.)

Accounting Rows

$$\sum_b TS_b \sum_a \sum_c \sum_d \sum_e \sum_f \sum_g X_{abcdefg} - \sum_b TS_b \sum_a \sum_c \sum_d \sum_e \sum_f \sum_g X_{abcdefg} = 0 \qquad 1.21$$

(Transfer of reduced tillage subsidies to YACTEQ and TXY rows.)

$$\sum_{c} V_c \sum_{a}\sum_{b}\sum_{d}\sum_{e}\sum_{f}\sum_{g} X_{abcdefg} - \sum_{c} V_c \sum_{a}\sum_{b}\sum_{d}\sum_{e}\sum_{f}\sum_{g} X_{abcdefg} = 0 \qquad 1.22$$

(Transfer of conservation practice subsidies to YACTEQ and TXY rows.)

Erosion Constraints

$$\sum_{a}\sum_{b}\sum_{c}\sum_{d}\sum_{e}\sum_{g} WWE_{bceg}\, X_{abcdefg} + \sum_{a}\sum_{e} WWE_{ae}\, XF_{ae} = WWEF \qquad 1.23$$

(The farm's water plus wind erosion may not exceed specified levels.)

$$\sum_{a}\sum_{b}\sum_{c}\sum_{d}\sum_{g} WWE_{bceg}\, X_{abcdefg} + \sum_{a}\sum_{e} WWE_{ae}\, XF_{ae} \leq WWES_e \qquad 1.24$$

(Water plus wind erosion for field e may not exceed specified levels.)

$$\sum_{a}\sum_{b}\sum_{c}\sum_{d}\sum_{e}\sum_{g} WE_{bceg}\, X_{abcdefg} + \sum_{a}\sum_{e} WE_{ae}\, XF_{ae} = WEF \qquad 1.25$$

(The farm's water erosion may not exceed specified levels.)

$$\sum_{a}\sum_{b}\sum_{c}\sum_{d}\sum_{g} WE_{bceg}\, X_{abcdefg} + \sum_{a}\sum_{e} WE_{ae}\, XF_{ae} \leq WES_e \qquad 1.26$$

(Water erosion for field e may not exceed specified levels.)

a = 1 . . . 5 crops

b = 1 . . . 5 tillages

c = 1 . . . 4 conservation practices

d = 1, 2, 3 plant/harvest periods

e = 1 . . . 7 soils (fields)

f = 1 . . . 6 water erosion groups (multiples of a soil's tolerance value);
7 . . . 12 total erosion (water plus wind) groups

g = 1 . . . 5 crop rotations

h = 1 . . . 18 labor supply periods

i = 1 . . . 15 taxable income levels

n = 1 . . . 14 income tax levels

A = Diversion payment per acre for one acre of crop a in acreage reduction program. Not all acres diverted necessarily receive a diversion payment.

B = Cover establishment costs per acre for one acre in acreage conservation reserve program.

C = cost/acre of crop a, tillage b, practice c, in plant/harvest period d, on soil e

D = income deficiency payment for one unit of commodity program crop a

E = off-farm ordinary income

F = acres of soil e

G = cost/acre of erosion of tillage b, practice c, rotation g, in plant/harvest period d, on soil e for erosion group f. See text for methodology.

H = field hours needed for crop a, tillage b, practice c, rotation g, in plant/harvest period d, on soil e

I = tax rate by taxable income level i

J = hours available for field work in period h

K = whole farm costs not directly associated with production, diversions, or taxes

L = taxable income level

M = K - personal tax exemptions

N = total income tax payment

P = price of one unit of crop a

R = subsidy per acre for production activities in erosion group f

S = Federal soil conservation subsidies (net of penalties)

T = total farm ordinary income less all costs and taxes

U = coefficient $\geq$ 0 and $\leq$ 1.0 to indicate use of 1 or 2 tax rates I

V = subsidy per acre for conservation support practice c

W = cost of crop yield reduction due to soil depletion

X = acres of crop a, crop rotation g, tillage b, practice c, in plant/harvest period d, on soil e

Y = crop yield per acre for crop a, crop rotation g, tillage b, practice c, in plant-harvest period d, on soil e

Z = objective function to maximize net after tax returns to land and management.

CP = commodity program payments

CR = crop rotation acres for a crop

CS = crop sales

CMAX = crop acre maximum

CMIN = crop acre minimum

CNVMAX = maximum conservation program payment per farm

COMMAX = maximum commodity program payment per person

PC = cash crop production costs

NTS = maximum no till subsidy per farm

RTMIN = reduced tillage acre minimum

S = soil conservation subsidy (or penalty)

SA = commodity acreage reduction program diversion requirement for a crop

TS = tillage subsidy per acre

TSMAX - maximum tillage subsidy per farm

WE = water erosion rate per acre

WEF = water erosion for the farm

WES = water erosion for a soil

WWE = water plus wind erosion rate per acre

WWEF = water plus wind erosion for the farm

WWES = water plus wind erosion for a soil

XF = acres in commodity acreage reduction program

Sample Tableau

Figure 1 presents a general picture of the LP simplex tableau. The eight crop production activities are combinations of the Oshtemo soil (4% slope), corn-corn-soybeans rotation, chisel-disk tillage, either using the vegetated critical area conservation practice or plowing straight up and down the field, crops of corn or soybeans, and one of two plant-harvest periods.

Figure 1. Sample LP tableau

		Crop production activities 1/								Sales, policy, and accounting activities												RHS	
		Up and down				Veg. critical area																	
		Corn		Beans		Corn		Beans															
		P_1H_1	P_2H_2	P_1H_1	P_2H_2	P_1H_1	P_2H_2	P_1H_1	P_2H_2	BNSAL	CNSAL	DFPAYCN	FMEROS	EROPEN	EROSUB	PRXSUB	SETCNAC	FMFXEXP	OFFINC	STFDTX	TRANSCSH		
		ac	ac	ac	ac	ac	ac	ac	ac	bu	bu	bu	tn	ac	ac	ac	ac	farm	farm	$	$		
OBJ																					1	MAX	
YACTEQ	$	294	294	294	294	293	293	293	293	-6.50	-2.53	-0.48		+	-	-	+	+	-	+		E	0
TXY	$	294	294	294	294	293	293	293	293	-6.50	-2.53	-0.48		+	-	-	+	+	-	+	1	L	0
ACTEQ																				1		E	1
BNYLD	bu			-42	-39			-42	-39	1												L	0
CNYLD	bu	-174	-162			-174	-162				1											L	0
DFPAYCN	bu	-174	-162			-174	-162					1										L	0
04AC	ac	1	1	1	1	1	1	1	1								1					L	+
04CCB21	ac	1	1	-2	-2																	E	0
04CCB26	ac					1	1	-2	-2													E	0
501514	hr	.42	.17	.17	.17	.42	.17	.17	.17													L	+
10231105	hr	.324			.76	.324			.76								.23					L	+
04EROS	tn	2.9	2.9	2.9	2.9	2.8	2.8	2.8	2.8								+					L	+
FMEROS	tn	2.9	2.9	2.9	2.9	2.9	2.8	2.8	2.8				-1				+					E	0
EROPEN	$	-	-	-	-	-	-	-	-					1								E	0
EROSUB	$	+	+	+	+	+	+	+	+						-1							E	0
PRXSUB	$	+	+	+	+	+	+	+	+							-1						E	0
MXCVNPAY	$														1	1						L	+
SETCNAC	ac																1					E	+
MXCRPPAY	$											.48										L	+
FMFXEXP	$																	1				E	1
OFFINC	$																		1			E	1
CHTILAC	ac	1	1	1	1	1	1	1	1													G	+
MAXCNAC	ac	1	1			1	1															L	+
MINBNAC	ac			1	1			1	1													G	+

1/ This example illustrates a corn-corn-soybean rotation, 4% Oshtemo soil, chisel-disk tillage, and either up and down the slope plowing or utilizing vegetation on critically eroding areas. Dashed lines are added for legibility.

Description of Matrix Rows

Row constraints--their purpose, units, and approximate number for the MLRA 98 farm, coefficients by column, and right-hand sides--are described in the following order:

	Typical name
o Accounting Tax Equality	(ACTEQ)
o Crop Rotation	(e.g., ORCB11)
o Crop Production	(e.g., CNYLD)
o Deficiency Payments	(e.g., DFPAYCN)
o Depletion Cost from Total Erosion	(DPCSTTOT)
o Depletion Benefit from Total Erosion	(DPBENTOT)
o Depletion Cost from Water Erosion	(DPCSTUSL)
o Depletion Benefit from Water Erosion	(DPBENUSL)
o Farm Fixed Expenses	(FMFXEXP)
o Field Areas	(e.g., F4AC)
o Income Accounting Equality	(YACTEQ)
o Labor Use	(e.g., 501514)
o Maximum Wheat Acres	(MAXWTAC)
o Minimum Crop Acres	(e.g., MINCNAC)
o Maximum Commodity Program Payment	(MXCRPPAY)
o Maximum Conservation Payment	(MXCVNPAY)
o Maximum Zero Till Subsidy	(MXZTILSB)
o Objective Function	(OBJ)
o Off-Farm Income	(OFFINC)
o Reduced Till Subsidy	(RTILSUB)
o Acreage Reduction (Set-Aside) Requirements	(e.g., SETCNAC)
o Conservation Practice Subsidy	(PRXSUB)
o Taxable Cash Income	(TXY)
o Tillage Acreage	(e.g., CHTILAC)
o Total Farm Erosion	(FMEROS)
o Total Field Erosion	(e.g., F4EROS)
o Total Erosion Subsidy/Penalty	(e.g., EROSUB1)
o Water Farm Erosion	(FMUSLE)
o Water Field Erosion	(e.g., F4USLE)
o Water Erosion Subsidy/Penalty	(e.g., USLSUB1)
o Zero Till Subsidy	(ZTILSUB)

NAME: Accounting Tax Equality (ACTEQ) 9/

PURPOSE: Force sum of 1-2 income tax payment activities to equal 1.0.

UNITS AND NUMBER OF ROWS: None; (1).

SIGN OF COLUMN COEFFICIENTS AND RHS:
- o STFDTXi: +1
- o RHS : = +1

NAME: Crop Rotation (Soil code/rotation code/tillage code/practice code) 10/

PURPOSE: Force the desired crop rotation combination.

UNITS AND NUMBER OF ROWS: acre; 1 for each soil/rotation/tillage/practice combination (126).

SIGN OF COLUMN COEFFICIENTS AND RHS:
- o No coefficients are needed for one crop (continuous); they are needed only for multicrop rotations.
- o Examples for selected crop rotations:
  - ORCB11: +1 in corn column of corn-beans activity; -1 in beans column. OR is a soil code, the first 1 is a crop code, the second 1 is a plant-harvest period code.
  - O4CCB11: +1 in corn column of corn-corn-beans activity; -2 in beans column. One unit (acre) of a bean activity requires 2 acres of corn activity for row constraint (2-2 = 0) to be met.
  - LCBW11: +1 in corn column of corn-corn-beans-wheat activity; -2 in beans column.
  - LBW11: +1 in beans column of corn-corn-beans-wheat activity; -1 in wheat column.
  - F80C11: +1 in corn column of corn-corn-oats-5 years alfalfa activity; -2 in oats column.
  - F80A511: -5 in oats column of corn-corn-oats-5 years alfalfa activity; +1 in alfalfa column.
- o RHS: = 0

9/ The software used, MINOS 5.0, allows up to 8 characters per name.

10/ For example, ORCB11 is Ormas soil, CB rotation, tillage 1, and conservation practice 1.

NAME: Crop Production (CNYLD, for example)

PURPOSE: Transfer crop production to TXY and YACTEO via crop sales activities.

UNITS AND NUMBER OF ROWS: Bu. or ton; 1 for each crop (5).

SIGN OF COLUMN COEFFICIENTS AND RHS:

- o Crop production: - annual yield per acre.
- o Crop sales: +1
- o RHS: ≤ 0

NAME: Deficiency Payments (DFPAYCN, for example)

PURPOSE: Account for and transfer deficiency payments to MXCRPPAY via columns of same name.

UNITS AND NUMBER OF ROWS: Bushel; 1 per commodity program crop (2).

SIGN OF COLUMN COEFFICIENTS AND RHS:

- o Crop production: - crop yield value
- o DFPAYCN and DFPAYWT: +1
- o RHS: ≤ 0

NAME: Depletion Cost from Total Erosion (DPCSTTOT)
Depletion Benefit from Total Erosion (DPBENTOT)

PURPOSE: Account for depletion costs or benefits from sheet and wind erosion and transfer to TXY and YACTEQ via column activities of the same name. 11/ Levy penalties/subsidies on excessive erosion by a per ton basis.

UNITS AND NUMBER OF ROWS: $; 1 for each (2).

SIGN OF COLUMN COEFFICIENTS AND RHS:

- o Crop production: - for DPCSTTOT AND + for DPBENTOT
- o DPCSTTOT: +1 or multiples for specified penalties
- o DPBENTOT: -1 or multiples for specified subsidies
- o RHS: = 0 for both rows

NOTE: If only sheet and rill erosion is considered, DPCSTTOT and DPBENTOT should not be transferred to TXY and YACTEQ. Do this by:

- o Crop production: as above
- o DPCSTTOT: zero
- o DPBENTOT: zero
- o RHS: $\leq$ 0 for DPCSTTOT
  : $\geq$ 0 for DPBENTOT
  : = 0 for DPCSTUSL
  : = 0 for DPBENUSL

	Production	DPBENTOT	DPCSTTOT	DPBENUSL	DPCSTUSL	RHS
TXY	XXX.XX			-1	1	$\leq$ 0
YACTEQ	XXX.XX			-1	1	= 0
DPBENTOT	X.XX					$\geq$ 0
DPCSTTOT	-X.XX					$\leq$ 0
DPBENUSL	X.XX			-1		= 0
DPCSTUSL	-X.XX				1	= 0

11/ Benefits (yield increases) from erosion are unusual occurrences.

NAME: Depletion Cost from Water Erosion (DPCSTUSL)
Depletion Benefit from Water Erosion (DPBENUSL)

PURPOSE: Account for depletion costs from water erosion and transfer to TXY and YACTEQ via column activities of the same name. Levy penalties/subsidies on excessive erosion by a per ton basis.

UNITS AND NUMBER OF ROWS: $; 1 for each (2).

SIGN OF COLUMN COEFFICIENTS AND RHS:

- o Crop production: - for DPCSTUSL and + for DPBENUSL
- o DPCSTUSL: +1 or multiples for specified penalties
- o DPBENUSL: -1 or multiples for specified subsidies
- o RHS: = 0 for both rows

NOTE: If only total (sheet and wind) erosion is being considered, then DPCSTUSL and DPBENUSL should not be transferred to TXY and YACTEQ. Do this by:

- o Crop production: as above
- o DPCSTUSL: zero
- o DPBENUSL: zero
- o RHS: $\leq$ 0 for DPCSTUSL
  : $\geq$ 0 for DPBENUSL
  : = 0 for DPCSTTOT
  : = 0 for DPBENTOT

	Production	DPBENTOT	DPCSTTOT	DPBENUSL	DPCSTUSL	RHS
TXY	+	-1	1			$\leq$ 0
YACTEQ	+	-1	1			= 0
DPBENTOT	+	-1				= 0
DPCSTTOT	-		1			= 0
DPBENUSL	+					$\geq$ 0
DPCSTUSL	-					$\leq$ 0

NAME: Farm Fixed Expenses (FMFXEXP)

PURPOSE: Force farm fixed expense activity into TXY and YACTEQ via column of same name.

UNITS AND NUMBER OF ROWS: None; (1).

SIGN OF COLUMN COEFFICIENTS AND RHS:

- o FMFXEXP: +1
- o RHS: = +1

NAME: Field Areas (F4AC, for example)

PURPOSE: Account for land area of each field or soil.

UNITS AND NUMBER OF ROWS: Acre; 1 per field (7).

SIGN OF COLUMN COEFFICIENTS AND RHS:
- o Crop production: +1
- o SETCNAC: +1, the least productive soil row for corn
- o SETWTAC: +1 in the least productive soil row for wheat
- o RHS: $\leq$ soil acreage

NAME: Income Accounting Equality (YACTEQ)

PURPOSE: Account for all cash income and tax deductible expenses and select Federal/State taxation activities.

UNITS AND NUMBER OF ROWS: $; (1).

SIGN OF COLUMN COEFFICIENTS AND RHS: Sign coefficients are as in TXY except:
- o STFDTX: +, taxable income levels (rather than Federal plus State taxes which are in the TXY row)
- o TRANCSH: 0
- o FMFXEXP: +, includes personal tax exemptions
- o RHS: = 0

NAME: Labor Use (initial month day/ending month day)

PURPOSE: Account for preplant, plant, cultivate and harvest labor use and limit to that available.

UNITS AND NUMBER OF ROWS: Hours; 1 for each time period (18).

SIGN OF COLUMN COEFFICIENTS AND RHS:
- o Crop production: +
- o SETCNAC: +
- o SETWTAC: +
- o RHS: $\leq$ hours of field time

NAME: Maximum Wheat Acres (MAXWTAC)

PURPOSE: Limit wheat acres to wheat base less acreage reduction requirement.

UNITS AND NUMBER OF ROWS: 1 acre; (1).

SIGN OF COLUMN COEFFICIENTS AND RHS:
- o Crop production: +1 in each wheat activity
- o RHS: $\leq$ wheat base less acreage reduction acres

NAME: Minimum Crop Acres (MINCNAC, for example)

PURPOSE: Force in particular crop to desired acreage.

UNITS AND NUMBER OF ROWS: 1 acre; 1 per crop (2).

SIGN OF COLUMN COEFFICIENTS AND RHS:
- o Crop production: +1
- o RHS: ≥ 0

NAME: Maximum Commodity Program Payment (MXCRPPAY)

PURPOSE: Account for and limit total deficiency and diversion payments per person to a prespecified level.

UNITS AND NUMBER OF ROWS: $/person; (1).

SIGN OF COLUMN COEFFICIENTS AND RHS:
- o SETWTAC: + paid diversion per acre
- o DFPAYCN and DFPAYWT: + value, by crop, of target price less loan rate
- O RHS: $\leq$ 50,000 or as specified

NAME: Maximum Conservation Payment (MXCVNPAY)

PURPOSE: Account for and limit soil conservation subsidies.

UNITS AND NUMBER OF ROWS: $; (1).

SIGN OF COLUMN COEFFICIENTS AND RHS:
- o RTILSUB: +1
- o SUBZTIL: +1
- o PRXSUB : +1
- o EROSUB : +1
- o USLSUB : +1
- o RHS: $\leq$ 500 or as specified

NAME: Maximum Zero Till Subsidy (MXZTILSB)

PURPOSE: Limit no till subsidies.

UNITS AND NUMBER OF ROWS: $; (1).

SIGN OF COLUMN COEFFICIENTS AND RHS:
- o SUBZTIL: positive value identical to ZTILSUB coefficient in no till crop production activities
- o RHS: $\leq$ some positive value

NAME: Objective Function (OBJ)

PURPOSE: Maximize net after-tax cash income.

UNITS AND NUMBER OF ROWS: $; (1).

SIGN OF COLUMN COEFFICIENTS AND RHS:
- o TRANSCSH: +1
- o RHS: maximize

NAME: Off-Farm Income (OFFINC)

PURPOSE: Force off-farm ordinary income into TXY and YACTEQ via column of same name.

UNITS AND NUMBER OF ROWS: $; (1).

SIGN OF COLUMN COEFFICIENTS AND RHS:
- o OFFINC: +1
- o RHS: = 1

NAME: Reduced Till Subsidy (RTILSUB)

PURPOSE: Subsidies for reduced tillages (not no till) and transfer to MXCVNPAY and to TXY and YACTEQ.

UNITS AND NUMBER OF ROWS: $; (1).

SIGN OF COLUMN COEFFICIENTS AND RHS:
- o Crop production: +
- o RTILSUB: -1
- o RHS: = 0

NAME: Acreage Reduction (Set-aside) Requirements (SETCNAC, for example)

PURPOSE: Force crop set-aside into TXY and YACTEQ via column of same name.

UNITS AND NUMBER OF ROWS: Acre; 1 for each commodity program crop (2).

SIGN OF COLUMN COEFFICIENTS AND RHS:

- o SETCNAC on least productive field: +1
- o SETWTAC on least productive field: +1
- o RHS: = specified value

NAME: Conservation Practice Subsidy (PRXSUB)

PURPOSE: Subsidize conservation practices and transfer to MXCVNPAY and to TXY and YACTEQ.

UNITS AND NUMBER OF ROWS: $; (1).

SIGN OF COLUMN COEFFICIENTS AND RHS:

- o Crop production: +
- o PRXSUB: -1
- o RHS: = 0

NAME: Taxable Cash Income (TXY)

PURPOSE: Account for all sources of cash inflows (crop sales; income deficiency payments; paid acre diversion; off-farm income; increased yields times crop price due to soil depletion; and subsidies) and cash outflows (crop production costs; decreased yields times crop price due to soil depletion; penalties; total fixed expenses including land rent, annual interest payments on long-term debt 12/, insurance, maintenance, utilities, and workman's compensation; set-aside establishment costs, State/Federal income taxes on ordinary income) and transfer the balance between inflows and outflows to OBJ.

UNITS AND NUMBER OF ROWS: $; (1).

SIGN OF COLUMN COEFFICIENTS AND RHS: 13/

Crop production:	+				
ALSAL :	-	BNSAL :	-	CNSAL :	-
DFPAYCN :	-	DFPAYWT :	-	DPBENTOT:	-1/0
DPCSTTOT:	+1/0	DPBENUSL:	-1/0	DPCSTUSL:	+1/0
EROPENi :	+1	EROSUBi :	-1	FMEROS :	0
FMFXEXP :	+	FMUSLE :	0	OFFINC :	-
OTSAL :	-	PRXSUB :	-1	RTILSUB :	-1
SETCNAC :	+	SETWTAC :	-	STFDTXi :	+ 14/
SUBZTIL :	-1	TRANSCSH:	+1	USLPENi :	+1
USLSUBi :	-1	WTSAL :	-		

RHS: $\leq$ 0

NAME: Tillage Acreage (CVNTILAC, for example)

PURPOSE: Force desired acreage of a tillage type.

UNITS AND NUMBER OF ROWS: 1 acre; 1 per tillage (4).

SIGN OF COLUMN COEFFICIENTS AND RHS:

- o Crop production: +1 in each activity for the specific tillage
- o RHS: $\geq$ specified value

12/ Interest and principal payments on short- and intermediate-term debt are included in production costs.

13/ Signs in TXY AND YACTEQ are - for cash inflows and + for cash outflows.

14/ Zero for STFDTX1.

NAME: Total Farm Erosion (FMEROS)

PURPOSE: Account for sheet and rill, and wind erosion at the farm level.

UNITS AND NUMBER OF ROWS: Ton; (1).

SIGN OF COLUMN COEFFICIENTS AND RHS:

- o Crop production, SETCNAC, SETWTAC: +1
- o FMEROS: -1
- o RHS: = 0

NAME: Total Field Erosion (F4EROS, for example)

PURPOSE: Account for sheet and rill, and wind erosion at the field level.

UNITS AND NUMBER OF ROWS: Ton; 1 for each soil (7).

SIGN OF COLUMN COEFFICIENTS AND RHS:

- o Crop production activities, SETCNAC, SETWTAC: +
- o RHS: $\leq$ multiple of T times field size

NAME: Total Erosion Subsidy/Penalty (EROSUB/EROPEN)

PURPOSE: Subsidize/penalize activities for sheet and rill plus wind erosion on per acre basis and transfer to MXCVNPAY, TXY, and YACTEQ.

UNITS AND NUMBER OF ROWS: $; 2 for EROSUB and 4 for EROPEN.

SIGN OF COLUMN COEFFICIENTS AND RHS:

- o Crop production: + for EROSUB and - for EROPEN
  - EROSUB1: erosion $\leq$ T
  - EROSUB2: T < erosion $\leq$ 1.5 T
  - EROPEN1: T < erosion $\leq$ 1.5 T
    EROPEN 1 and EROSUB2 should not both have coefficients in the same run
  - EROPEN2: 1.5 T < erosion $\leq$ 2.0 T
  - EROPEN3: 2.0 < erosion $\leq$ 2.5 T
  - EROPEN4: 2.5 T < erosion
- o $EROSUB_i$: - 1.0 in $EROSUB_i$ row
- o $EROPEN_i$: + 1.0 in $EROPEN_i$ row
- o RHS: = 0

NAME: Water Farm Erosion (FMUSLE)

PURPOSE: Account for sheet and rill erosion at the farm level.

UNITS AND NUMBER OF ROWS: Ton; (1).

SIGN OF COLUMN COEFFICIENTS AND RHS:
- o Crop production, SETCNAC, SETWTAC: +1
- o FMUSLE: -1
- o RHS: = 0

NAME: Water Field Erosion (F4USLE, for example)

PURPOSE: Account for sheet and rill erosion by field.

UNITS AND NUMBER OF ROWS: Ton; 1 for each soil (7).

SIGN OF COLUMN COEFFICIENTS AND RHS:
- o Crop production, SETCNAC, SETWTAC: +
- o RHS: $\leq$ specified level

NAME: Water Erosion Subsidy/Penalty (USLSUB/USLPEN)

PURPOSE: Subsidize/penalize activities for excessive sheet and rill erosion on per acre basis and to transfer to MXCVNPAY, TXY, AND YACTEQ.

UNITS AND NUMBER OF ROWS: $; 2 for USLSUB and 4 for USLPEN.

SIGN OF COLUMN COEFFICIENTS AND RHS:
- o Crop production: + for USLSUB and - for USLPEN
  - USLSUB1: erosion $\leq$ T
  - USLSUB2: T < erosion $\leq$ 1.5 T
  - USLPEN1: T < erosion $\leq$ 1.5 T
    - USLSUB2 and USLPEN1 should not both have coefficient values in any one run
  - USLPEN2: 1.5 T < erosion $\leq$ 2.0 T
  - USLPEN3: 2.0 T < erosion $\leq$ 2.5 T
  - USLPEN4: 2.5 T < erosion
- o $USLSUB_i$: - 1.0 in $USLSUB_i$ row
- o $USLPEN_i$: + 1.0 in $USLPEN_i$ row
- o RHS: = 0

NAME: Zero Till Subsidy (ZTILSUB)

PURPOSE: Subsidize no till and transfer to MXCVNPAY, TXY, and YACTEQ.

UNITS AND NUMBER OF ROWS: $; (1).

SIGN OF COLUMN COEFFICIENTS AND RHS:
- o Crop production: +
- o SUBZTIL: -1
- o RHS: = 0

Column Activities

Column activities are now presented.

Crop Production Activities

Codes: 6-digit code in which each digit represents a Soil/Rotation/Tillage/Practice/Crop/Plant-Harvest Period

1. Soil: 1-Ormas; 2-Oshtemo 4%; 3-Locke; 4-Fox 4%; 5-Hillsdale-Riddle; 6-Fox 8%; 7-Oshtemo 18%. In MPS Input file, codes are A, B, C, D, E, F, respectively. Soil 7 is wholly used for corn acreage reduction requirement; soil 6 is partially used for wheat acreage reduction requirement.

2. Rotation: 1-CC; 2-CCB; 3-CB; 4-CCBWX; 5-CCOA5.

3. Tillage: 1-Conventional Spring; 2-Chisel; 5-Plow plant; 6-Zero Till; 7-Subsidized Zero Till.

4. Practice: 1-Up and down the field; 2-Waterway; 3-Diversion with Contours; 6-Vegetated Critical Area.

5. Crop: 1-Corn; 2-Soybean; 3-Wheat w/cover; 4-Oats; 7-Alfalfa.

   Crop codes do not vary for irrigated or dryland. Only irrigated corn and soybean yields are input to soils 1, 2, 4 and 5; only dryland on soils 3 and 6.

6. Plant-Harvest Period: 1-plant on time/harvest on time (P_1H_1); 2-plant on time/harvest late (P_1H_2); 3-plant late/harvest late (P_2H_2).

o The following options, some 900 crop production activities, are in the MLRA 98 model:

Soil	Rotations	Tillage	Practice	P/H
1, 2 (A,B)	1, 2, 3	1, 2, 5, 6, 7	1, 6	1, 2, 3
3 (C)	1, 2, 3, 4	1, 2, 5, 6	1	1, 2, 3
4, 5 (D, E)	1, 2, 3	1, 2, 5, 6	1, 2, 3	1, 2, 3
6 (F)	1, 2, 3, 5	1, 2, 5, 6	1	1, 2, 3
7 (G) 15/				

o Units: 1 acre

Crop Sales - 5
- o CNSAL, BNSAL, OTSAL, WTSAL, ALSAL
- o Unit: 1 unit of production per acre

Farm Water Erosion - 1
- o FMUSLE
- o Unit: ton

Farm Total Erosion - 1
- o FMEROS
- o Unit: ton

Depletion Cost from Water Erosion - 1
- o DPCSTUSL
- o Unit: 1 acre

Depletion Benefit from Water Erosion - 1
- o DPBENUSL
- o Unit: 1 acre

Depletion Cost from Total Erosion - 1
- o DPCSTTOT
- o Unit: 1 acre

Depletion Benefit from Total Erosion - 1
- o DPBENTOT
- o Unit: 1 acre

Farm Fixed Expenses - 1
- o FMFXEXP
- o Unit: 1 farm

Acreage Reduction (Set-Aside) Acres - 2
- o SETCNAC
- o SETWTAC
- o Unit: 1 acre

15/ When the farm is taken out of the commodity program, options on soil 7 are the same as those on soil 6.

Deficiency Payments - 2
- o DFPAYCN
- o DFPAYWT
- o Unit: 1 unit of production

Reduced Tillages Subsidy - 1
- o RTILSUB
- o Unit: 1 acre

Zero Tillage Subsidy - 1
- o SUBZTIL
- o Unit: 1 acre

Practice Subsidy - 1
- o PRXSUB
- o Unit: 1 acre

Total Erosion Subsidy - 2
- o EROSUBi
- o Unit: acre

Total Erosion Penalty - 4
- o EROPENi
- o Unit: acre

Water Erosion Subsidy - 2
- o USLSUBi
- o Unit: acre

Water Erosion Penalty - 4
- o USLPENi
- o Unit: acre

Off-Farm Income - 1
- o OFFINC
- o Unit: 1 farm

State/Federal Income Taxes - 15
- o STFDTX1-15
- o Unit: $

Transfer Net Cash Income - 1
- o TRANCSH
- o Unit: none

Explanation of Coefficients for Selected Activities 16/

Row constraint	Column activity	Notes
CNYLD	Production	Annual yield per acre that vary by soil (field) and dates of planting and harvesting.
DFPAYCN	Production	Annual yield per acre.
DPCSTTOT	Production	Annual amount of money the farmer could begin to invest in conservation now and each year hereafter to capture benefits (of no yield reductions due to soil depletion) of controlling erosion to T or below. See (9).
DPCSTTOT	DPCSTTOT	1 to transfer to TXY and YACTEQ rows or multiples of 1 to simulate social penalties for excessive erosion. DPCSTTOT and DPBENTOT should not be used at same time as DPCSTUSL and DPBENUSL because of double-counting.
Labor	Production and set-asides	Field labor required for preplant, plant, cultivate, and harvest operations.
Labor	RHS	Hours available for field work as determined by number of operators, number of hours worked per day, and weather suitability.
MXCVNPAY	RHS	The value is set by the ASCS county committee and the Soil Conservation District board. It varies widely by county and year. $500 is chosen from a range estimated by ASCS and $200-800 per year.
MXZTILSB	RHS	In Branch County, a targeted area of MLRA 98, a farm can receive $14/acre for 30 acres for one year.

16/ Notes for the selected row and/or column activity often apply to similar activities. For example, CNYLD notes apply to BNYLD, ALYLD, etc.

Row constraint	Column activity	Notes
YACTEQ	FMFXEXP	Value in TXY row plus personal tax exemptions.
	STFDTXi	Taxable income levels; positive sign.
	Other columns	Same values as in row TXY.
TXY	CNSAL, WTSAL	ASCS established national average market price. For analyses of farm outside of commodity program, market prices from Michigan Farmer are used for all crops.
TXY	ALSAL, BNSAL OTSAL	Market prices as reported in 1-5-85 Michigan Farmer.
TXY	DFPAYCN DFPAYWT	Difference between ASCS market prices and loan rates for corn and wheat.
TXY	FMFXEXP	Includes exogenous calculation for cash land rent, annual interest payment on long-term debt, insurance, utilities, and farm maintenance. Excludes personal tax exemptions. The farm is assumed to have no crop inventory, as all is sold at harvest.
TXY	STFDTXi	Federal plus State taxes; positive sign.
TXY	SETCNAC	Annual cost of establishing a 3-year conservation cover is assumed to be the 1/3 of that for establishing cover following winter wheat.
TXY	SETWTAC	Diversion payments are made at $2.70/bu. times ASCS-established yield times one-third of the acres set aside less establishment cost.

Row constraint	Column activity	Notes
TXY 17/	Production	Average annual production cost per acre to land and management from ERS/SCS Budget 3 report (17). For activities with conservation support practices, annual operation and main finance costs are included. Labor cost includes self-employment taxes.
F4EROS and F4USLE	Production	Sheet and rill erosion calculated with the USLE plus wind erosion calculated with Chepil equation.

DATA COLLECTION

The overall project objective of developing a flexible analytical tool that may be used either directly or with minor modifications in several MLRAs affects data collection by emphasizing use of existing data sets.

Crop Production Costs

With a few exceptions, crop production costs developed by Michigan's SCS and ERS staff were used for this study (17). SCS/ERS relied upon ERS Farm Enterprise Data System (FEDS) budgets to develop machine costs for field operations (14). In general, ERS computed machine costs by adding FEDS

17/ Taxable income is:

	Cash income from crop sales, government programs, other farm work.
less	Operating expenses (fertilizer, seed, chemicals, lime, operating capital interest; machinery repairs, depreciation, fuel; hired and custom labor, workman's compensation and/or social security taxes; drying; hauling; cash land rent).
less	Other expenses not directly tied to production (fire and wind insurance; real estate tax on land and buildings; utilities; interest on intermediate and long-term debt; conservation maintenance, repairs to fences, buildings, etc.).
equals	Net farm income before tax.
plus	Ordinary nonfarm income.
less	Personal exemptions, other.
equals	Taxable income.
less	Federal and State taxes.
plus	Tax credits.
equals	Net cash income after taxes.

total machinery ownership costs (depreciation, interest, insurance, and taxes) and FEDS repair costs; fuel cost by multiplying local fuel prices by FEDS fuel usage/hour and then summing with FEDS lubricant costs; and, hours per acre of use by using FEDS speed and field efficiency factors times machine width. ERS and SCS staff estimated seed, fertilizer, chemicals, operating capital interest, labor, and hauling/drying costs from MSU and SCS crop budgets and SCS field staff judgement.

SCS/ERS modified cost of crop production to account for conservation practices by: reducing crop yield by an amount equal to the proportion of one acre used by the practice; reducing cost of production by half of the yield rate reduction; and reducing the FEDS field efficiency factor by 10 percent for diversions with contours, 1 percent for grassed waterways, and 1 percent for vegetated critical areas. Conservation practice costs were developed by SCS field staff. Sample report formats from the SCS/ERS automated budget generator are presented in the Appendix.

Crop Labor Supply and Demand

Labor supply for agricultural field work is a function of: (1) the number of operators working during different time periods; (2) hours per day per operator; and (3) probability of weather being suitable for agricultural operations.

Two full-time operators were assumed to be available on this farm for all time periods. Hours worked per day were drawn from several Michigan State University (MSU) sources (3, 5) for southern Michigan and verified with Extension Service field staff. Weather conditions limit the number of hours suitable for field work. Suitability also depends on soil type. MSU data for the predicted portion of days suitable for nonharvest and for harvest work on well-drained, sandy loam soils in southern Michigan were consulted. Labor supply coefficients by week are presented in table 2.

Total labor requirements come from SCS/ERS crop budgets. Harvest operation labor requirements such as combining generally vary by yield while nonharvest operations do not. Once labor requirements are estimated for a particular yield, timing of crop operation within the production cycle must be determined. This step is critical as labor constraints in the agricultural cycle influence cropping system choices. In this model, corn and soybean planting and harvesting periods are targeted *a priori* as the most likely periods in which labor would be limiting. Planting and harvesting dates that are most timely and enjoy full crop yields were identified from several sources and verified with Extension Service field staff. The planting and harvesting periods for southern Michigan are presented in table 3.

Table 2--Labor supply coefficients, by week 1/

Week	Probability of agricultural activity	Daily work hours per labor unit	Weekly hours per labor units	Farm labor available with two labor units
319-325	0.14	8	7.8	15.7
326-402	.14	8	7.8	15.7
403-409	.16	8	9.0	17.9
410-416	.25	8	14.0	28.0
417-423	.30	10	21.0	42.0
424-430	.45	12	37.8	75.6
501-507	.60	14	58.8	117.6
508-514	.554	14	54.3	108.6
515-521	.541	14	52.5	105.0
522-528	.63	14	61.7	123.4
529-604	.504	12	42.0	84.0
605-611	.41	12	34.3	68.6
612-618	.508	10	35.6	98.6
619-625	.64	10	44.8	89.6
626-702	.591	10	47.4	94.8
703-709	.77	10	53.9	107.8
710-716	.76	10	53.2	106.4
717-723	.70	10	49.0	98.0
724-730	.70	10	49.0	98.0
731-806	.734	10	51.4	102.4
807-813	.74	10	51.8	103.6
814-820	.733	10	51.3	102.6
821-827	.73	10	51.1	102.2
828-903	.606	10	45.4	90.4
904-910	.54	10	37.8	75.6
911-917	.574	10	40.2	80.4
918-924	.66	10	46.2	92.4
925-1001	.651	10	45.6	91.4
1002-1008	.60	12	50.4	100.8
1009-1015	.60	12	50.4	100.8
1016-1022	.65	12	54.6	109.2
1023-1029	.65	12	54.6	109.2
1030-1105	.543	12	45.9	91.2
1106-1112	.50	12	42.0	84.0
1113-1119	.414	12	34.8	69.6
1120-1127	.40	12	33.6	67.2
1127-1203	.25	10	17.5	35.0

1/ Weeks are grouped into 18 single and multiweek periods for LP row constraints. These periods are March 19-April 23, April 24-30, May 1-14, May 15-21, May 22-28, May 29-June 4, June 5-25, July 10-16, July 17-23, July 24-August 6, August 7-20, August 21-September 3, September 4-24, September 25-October 8, October 9-22, October 23-November 5, November 6-12, November 13-27.

Table 3--MLRA 98 representative farm planting and harvesting periods

Crop-tillage	Planting		Harvesting	
	Timely (P_1)	Late (P_2)	Timely H_1	Late H_2
Corn				
Conv. spring	4/24-5/14	5/15-5/28	10/9-11/12	11/13-11/27
Other 1/	5/1-5/14	5/15-5/28	10/9-11/12	11/13-11/27
Soybeans				
Conv. spring	5/15-5/28	5/29-6/13	9/24-10/22	10/23-11/5
Other 1/	5/15-5/28	5/29-6/13		
Wheat				
Conv. spring	9/25-10/15	10/16-10/30	7/17-8/6	8/7-8/20
Other 1/	9/25-10/15	10/16-10/30		
Oats	4/10-5/7	5/8-5/21	7/24-8/13	8/14-8/20
Alfalfa 2/	w/oats	w/oats	5/22-6/11	6/12-6/25
			7/10-7/23	7/24-8/6
			8/21-9/3	9/4-9/24

1/ Chisel, plow plant, and no till for corn and soybeans; chisel and no till for wheat.

2/ Planted with oats the first year; harvested for 5 years.

Once timing of individual tasks such as disking has been approximated, those tasks are aggregated into preplant, plant, harvest, and operations. 18/ Labor coefficients by individual task are then summed and spread evenly over the proper aggregate operation. Finally, the weeks shown earlier are grouped into 18 single week and multiweek periods; the least amount of grouping is done during planting and harvesting because of the critical effect of these times on crop yields. These 18 periods shown in the footnote to table 2 account for supply and demand for labor in the LP. An example of labor requirements for corn and soybeans is presented in table 4.

18/ Tasks by operation are:

Preplant--plowing, disking, harrowing, fertilization, preplant pesticide/insecticide application.

Planting--fertilizer and chemicals applied during planting plus other activities done after planting but before harvesting such as cultivating, NH3 injection, or pesticide applications.

Harvesting--combining grain; use of grain wagon and/or transport truck; row/conditioning, raking, baling, and transporting hay bales.

Table 4--Labor requirements for nonirrigated corn and soybeans by plant-harvest period 1/

Item	Corn			Soybeans		
	P_1H_1	P_1H_2	P_2H_2	P_1H_1	P_1H_2	P_2H_2
	Hours/acre					
Nonharvest:						
319-423	0.200	0.200	0.200	0.200	0.200	0.200
424-430	.184	.184	.100	.100	.100	.100
501-514	.366	.366	.200	.200	.200	.200
515-521			.125	.084	.084	
522-528			.125	.084	.084	
529-604				.084	.084	
605-625	.390	.390	.390	.170	.170	.420
Harvest: 2/						
925-1008				.380		
1009-1022	.284			.380		
1023-1105	.284				.760	.760
1106-1112	.124					
1113-1127		.710	.710			

1/ Conventional tillage on Locke. P_1 is planting on time: P_2 is planting late; H_1 is harvesting on time; H_2 is harvesting late.

2/ Harvest labor depends partly on crop yield. This example assumes a corn yield of 103-109 bu/ac. and soybean yield of less than 46 bu/ac.

Crop Yields

Crop yields are a function only of soil type. Yields in the SCS/ERS data set show increased yields for reduced tillage and zero till relative to conventional spring tillage. These increases are generally only possible by also applying a more intensive level of management, one that involves knowing precisely the timing and application rates of fertilizers and chemicals required for reduced and zero tillages. After discussion with SCS, we decided to hold yields constant relative to tillage.

Crop yields are modified for late planting or harvest. Through discussions with Extension Service staff and review of widely differing literature, we estimated values of a 1-percent loss of yield for harvesting either corn, soybeans, or wheat up to 2 weeks late (P_1H_2) and a 7-percent loss of yield for planting up to 2 weeks late (P_2H_2) for use in this model.

Whole Farm Fixed Expenses

Four categories of whole farm fixed expenses are considered: land rent; annual interest payments on long-term debt; insurance, maintenance, farm utilities, and workmen's compensation; and State and Federal taxes, less personal exemptions, on ordinary income.

Two general types of land rent are prevalent in the southern part of MLRA 98: cash rent and share rent. A typical share rent is one in which owner and renter equally share variable input costs. The cash rent option was chosen for this model. Cash rents vary widely, from levels of $30 to $80 per acre. Consultation with agency field staff and other sources (11) led to the selection of $75/acre for irrigated or tiled land and $40/acre for nonirrigated or untiled land. If the land is irrigated, the owner supplies traveler and/or center pivot equipment. The number of acres owned and rented is established exogenously and easily varied.

Long-term debt service requires estimates of assets and liabilities. Three general asset categories are considered. Cropland value estimates of $1,000 per acre, whether irrigated or dryland, were obtained from agency field staff. Second, the average value of buildings based on cost less depreciation was taken from Extension Service data for 400-acre to 800-acre cash grain farms (1). Third, the farm dwelling was arbitrarily valued at $50,000. The value of farm machinery is not included because it is included in the cost of crop production (14). It is assumed that the farm has no crop inventory but that all crop production is sold at harvest. As an example, total assets for the 700-acre farm with no acreage rented from another were estimated at $790,000.

With respect to liabilities, as of the fourth quarter of 1984, the Federal Land Banks charged 11.4 percent on new loans, Farmers Home Administration charged 10.45 percent except for "limited resource" farms, insurance companies charged 12.55 percent, and the prime rate was 11 percent. An 11-percent interest rate and 30-year fixed term were assumed for this study. All payments were considered to be for interest only. 19/

Insurance, maintenance on fences, buildings, and conservation investments are based on 1983 Extension Service data for a 400-acre to 800-acre cash grain farm (1). The estimate of $19/acre includes repairs on buildings, fences and wells, bulldozing, cleaning ditches and fence rows; fire and wind insurance premiums, depreciation, and interest on conservation improvements.

Finally, Federal and State of Michigan income taxes are calculated. Four personal exemptions are allowed. The farmer has only ordinary, no capital gains, income. Michigan property taxes are ignored because at the State level, property tax credits for farmers are nearly equivalent to their property tax bill. Income taxes are included in the LP tableau using a method published by Vandeputte (18). Soil conservation expenses are considered fully tax deductible. Federal cost-share payments are nontaxable. 20/

19/ Interest payments are tax-deductible; principal payments are not. In early years of an obligation, the former far outweigh the latter. For example, in the first year of a 30-year, $200,000 note, interest payments are $21,955; principal payments are $894. By the tenth year, principal payments have risen to $2,688.

20/ Expenses for nondepreciable activities such as earth moving are currently deductible from Federal taxes up to 25 percent of gross farm income. This would include terraces, diversions, and grassed waterways, for example. It does not include drain tiles. These deductibility provisions are being considered for elimination in the tax reform.

Erosion and Soil Depletion

All erosion estimates came from the SCS/ERS data set (17). Sheet and rill erosion was calculated for each soil-crop rotation-tillage, and conservation practice using the Universal Soil Loss Equation (USLE). Wind erosion was calculated with the Chepil wind erosion equation. Although this equation has been shown to be unsatisfactory for many soils, it is well adapted to the sandy soils of this MLRA. The Appendix presents the type of erosion report available from the Michigan SCS office.

Soil depletion estimates were included in the LP in response to concerns that crop yields would fall (over time), if erosion exceeded the tolerable soil loss value (T) for any particular soil. The model used to calculate longrun economic and productivity effects of soil erosion was Kugler's adaptation of the Pierce-Larsen model (9). Important soil parameters included are changes in bulk density, permeability, available water capacity, and pH by soil horizon in the soil profile. The economic component of the model uses present value and capitalization theory to derive an economic measure of the benefits which a farmer can begin to capture now by controlling erosion to a rate less than or equal to a soil's T-value. Meeting this erosion control objective arrests any potential long-term productivity loss and yield levels would be sustained into perpetuity. Table 5 presents a sample report from Kugler's model showing:

- the T-value, depth, texture, bulk density, available water capacity, pH, and drainage class by horizon for a 4-percent slope Ormas loamy sand soil;
- the crop rotation, tillage, conservation practice, erosion rate, market price, cost of production, and discount rate; and
- the model's annual computations by year for 25 years of soil depth lost, productivity index (PI), corn yield, net returns, present value of benefits which the operator can begin to capture now by controlling erosion to T or below, and the annual amount (MAECP) the farmer could begin to invest in soil conservation now and each year hereafter to exactly capture the present value benefit in the 25th year. MAECP is equivalent to yield depletion cost; in this example, $1.21 per acre.

Commodity Program Participation

Information concerning commodity provisions in Titles III and IV (wheat and feed grains) of the Agriculture and Food Act of 1981 relating to 1985 production was largely obtained from State and county staff of ASCS (12).

1985 Feed Grain Program.

Relevant provisions to this LP model structure are:

- Target prices: The national target price for corn is $3.03/bu. Because of the insignificance of oats and barley in this MLRA, it is assumed the farmer does not participate in the program for those crops.

Table 5. Soil depletion estimate

VERSION 1.1 SOIL DEPLETION ESTIMATE DATE: 2/ 7/85

ADAPTED PIERCE/LARSON/DOWDY/GRAHAM MODEL FROM JSWC JAN/FEB 1983

ECONOMIC RESEARCH SERVICE , NATURAL RESOURCE ECONOMICS DIVISION , NORTHEAST SECTION 2/84

BRANCH REP FARM

ORMAS LS ON 4 PERCENT SLOPE T VALUE = 5.0

UNWEIGHTED PRODUCTIVITY INDEX-PI-CALCULATIONS BY SOIL HORIZON

HORIZON	DEPTH-CM	TEXTURE	BULK DENSITY-G/CM3	AVAILABLE WATER-IN/IN	REACTION-PH	UNWEIGHTED PI BY HORIZON
1	61.0	CLOAM	1.500	0.110	6.450	0.55
	SUFFICIENCIES		1.00	0.55	1.00	
2	96.5	SANDY	1.525	0.080	6.050	0.40
	SUFFICIENCIES		1.00	0.40	1.00	
3	111.8	CLOAM	1.600	0.130	5.800	0.54
	SUFFICIENCIES		0.86	0.65	0.97	
4	149.9	CLOAM	1.550	0.125	6.800	0.57
	SUFFICIENCIES		0.92	0.62	1.00	
5	162.6	SANDY	1.625	0.040	7.900	0.16
	SUFFICIENCIES		0.95	0.20	0.85	

ROTATION = CCC IRR CONT CORN W/WIND

TILLAGE METHOD = CONVEN SPRNG CONSERVATION PRACTICE = UP & DOWN

EROSION RATE = 12.80

PRICES CORN 2.75 WHEAT 3.35 SOYBN 6.50 ALFHY 53.38

COST OF PRODUCTION = 338.55 DISCOUNT RATE = 8.375 PERCENT

YEAR	DEPTH LOST CM	PCT PI	YLD 1 CORN	YLD 2 WHEAT	YLD 3 SOYBN	YLD 4 ALFHY	NET RETURN	PRES VAL BENEFIT	MAECP	PRES VAL AG.LAND
1	0.00	100.00	165.0				115.20	0.00	0.00	1375.52
2	0.19	99.97	165.0				115.08	1.32	0.11	1267.91
3	0.38	99.95	164.9				114.96	2.54	0.21	1168.70
4	0.57	99.92	164.9				114.84	3.67	0.31	1077.26
5	0.77	99.89	164.8				114.72	4.72	0.39	992.96
6	0.96	99.87	164.8				114.60	5.68	0.48	915.26
7	1.15	99.84	164.7				114.48	6.58	0.55	843.64
8	1.34	99.81	164.7				114.35	7.40	0.62	777.62
9	1.53	99.79	164.6				114.23	8.17	0.68	716.76
10	1.72	99.76	164.6				114.11	8.88	0.74	660.66
11	1.91	99.73	164.6				113.99	9.53	0.80	608.95
12	2.10	99.71	164.5				113.86	10.14	0.85	561.29
13	2.30	99.69	164.5				113.80	10.42	0.87	517.63
14	2.49	99.66	164.4				113.68	10.94	0.92	477.11
15	2.68	99.64	164.4				113.56	11.42	0.96	439.76
16	2.87	99.61	164.4				113.43	11.86	0.99	405.33
17	3.06	99.58	164.3				113.31	12.27	1.03	373.60
18	3.25	99.55	164.3				113.18	12.65	1.06	344.35
19	3.44	99.53	164.2				113.06	13.00	1.09	317.39
20	3.63	99.50	164.2				112.93	13.33	1.12	292.53
21	3.83	99.47	164.1				112.81	13.63	1.14	269.63
22	4.02	99.44	164.1				112.68	13.91	1.16	248.51
23	4.21	99.41	164.0				112.55	14.17	1.19	229.05
24	4.40	99.40	164.0				112.49	14.29	1.20	211.23
25	4.59	99.37	164.0				112.36	14.51	1.21	194.69
HORIZON			1	2	3	4	5			
YEARS TO LOSE			318.2	188.3	85.1	205.4	71.8			

1.UNWEIGHTED PI BY HORIZON = BULK DENSITY SUFFICIENCY * AVAILABLE WATER SUFFICIENCY * PH SUFFICIENCY.
2.YEAR = YEAR OF CONVERSION TO RESOURCE MGT. SYSTEM ERODING AT OR BELOW T VALUE.
3.DEPTH LOST = CUMULATIVE DEPTH OF SOIL LOST PRIOR TO YEAR OF CONVERSION.
4.PCT PI = NORMALIZED WEIGHTED PRODUCTIVITY INDEX USED FOR INTERNAL CALCULATIONS OF YIELD CHANGE.
5.YLD = ESTIMATED YIELD FOR YEAR OF CONVERSION.
6.NET RETURN = YIELDS * MARKET PRICES - COST OF PRODUCTION.
7.PRES VAL BENEFIT = PRESENT VALUE OF BENEFITS LOST = CAPITALIZED VALUE OF AG. LAND(YEAR 1) - PRESENT VALUE OF NET RETURNS(TO YEAR N-1) - PRESENT CAPITALIZED VALUE OF AG LAND(YEAR N).
8.MAECP = ANNUITY OF PRES VAL BENEFIT.
9.PRES VAL AG. LAND = CAPITALIZED PRESENT VALUE OF AG. LAND = DISCOUNTED NET RETURNS(YEAR N) / CAPITALIZATION(DISCOUNT) RATE.

- o Loan rates: The national average price support rate for corn is $2.55/bu. The State rate set by Michigan ASCS is $2.53/bu.

- o Planting limitations: The producer must limit corn acreage planted for harvest to not more than 90 percent of the farm's feed grain base for corn-sorghum. The feed grain base established for barley-oats is not relevant to this farm.

- o Acreage base: The 1985 acreage base is the average of acreage planted and considered planted to feed grains in 1983 and 1984.

- o Acreage reduction: A 10-percent reduction in feed grain acreage is required. There is no paid diversion on these acres.

- o Income deficiency payments: Deficiency payments are national target prices ($3.03/bu.) less the national loan rate ($2.55/bu.). Although not relevant to this model structure, it is noted that sign-up for both the feed grain and the wheat programs is from October 15, 1984, to March 1, 1985.

  Producers may request half of their projected deficiency payment at sign-up.

- o Acreage conservation reserve (ACR): Eligible cropland equal to 12.11 percent of planted acreage must be devoted to the ACR. Land designated to the ACR must have been devoted to row crops or small grains in 2 of the last 3 years. The land must be protected from water and wind erosion throughout the year. Haying is not permitted. ACR land may be grazed except during the five principal growing months designated by ASCS county committees.

1985 Wheat Program

Relevant provisions to this LP model structure are:

- o Target price: $4.38/bu.

- o Loan rate: $3.30/bu. is the national loan rate; $3.27 is the loan rate established by Branch County ASCS.

- o Acreage base: The average of the acreage planted and considered planted to wheat in 1983 and 1984.

- o Acreage reduction: A 30-percent reduction in wheat acreage is required. This is a 20-percent unpaid acreage diversion and a 10-percent paid diversion. The paid diversion rate is $2.70/bu. times the ASCS-established yield rate for the farm (42 bu. in this farm).

- o Income deficiency payments: Deficiency payments are $1.11/bu. in this area of Michigan. Although not relevant to this model, it is noted that half of the paid diversion and the income deficiency payment is available at sign-up.

- o Acreage conservation reserve (ACR): Eligible cropland equal to at least 28.57 percent of the farm's planted wheat acreage plus 10 percent of the wheat base must be devoted to ACR. Land designated to the ACR must have been devoted to row crops or small grains in 2 of the last 3 years. Haying is not permitted. ACR land may be grazed except during the 6 principal growing months.

As discussed earlier in this paper, the producer of the MLRA 98 farm is assumed to participate fully in corn and wheat program provisions. The timing of sign-up and receipt of payments is not considered in the LP. The farmer is assumed to secure a CCC loan for these crops, to default fully on these loans at harvest, and to receive payment at the loan rate and deficiency payment.

The model can also be used to help analyze policy impacts on a farm not participating in commodity programs. For such model runs, market prices, $2.65/bu. for corn and $3.38/bu. for wheat, are used. Acreage reductions, target prices, loans, and deficiency payments are not relevant.

Debt Repayment Capacity

Family living expenses are exogenously subtracted from the LP solution for net after-tax income to generate an estimate of the operator's ability to pay principal on existing long-term debt or to acquire additional debt. Living expense estimates for a farm family could not be obtained. Estimates for expenditures of a mix of nonfarm suburban and urban families in 1983 include detail for food, rent or mortgage, utilities, household operations, furniture and equipment, car payment and operation, clothing, personal care, gifts, recreation, education, medical, insurance, miscellaneous, installment debt, and taxes (6). 21/

21/ 1981-1984 data from farm business records gathered by the Illinois farm business associations in cooperation with the University of Illinois Extension Service and Department of Agricultural Economics indicate that living expenses for farm families are more closely related to net worth than to net income.

The LP for the MLRA 98 farm is installed at the Washington Computer Center and may be optimized using MINOS 5.0 (Modular In-Core Nonlinear Optimization System) (19). The output report of a sample optimization run is presented below.

```
                        TOTAL       NORMAL        FREE       FIXED     BOUNDED
ROWS                      222           60           1         161           0
COLUMNS                   997          996           0           1           0

NO. OF MATRIX ELEMENTS    18634     DENSITY       8.419
NO. OF REJECTED COEFFS     3129      AIJTOL 1.00000E-10
BIGGEST AND SMALLEST COEFFS   1.62400E+05   1.60000E-02  (EXCLUDING OBJ AND RHS)
XXXX  TOTAL NUMBER OF ERRORS DURING INPUT       9
ITN    0 -- INFEASIBLE.  NUM =    9   SUM =   2.772080246E+03
ITN   28 -- FEASIBLE SOLUTION.  OBJECTIVE =   3.068021249E+04
ITN   50 -- FEASIBLE SOLUTION.  OBJECTIVE =   3.422539988E+04
EXIT -- OPTIMAL SOLUTION FOUND.
STATUS          OPTIMAL SOLN          PHASE        2     ITERATION     89

SECTION 1 - ROWS

 NUMBER  ...ROW..  AT  ...ACTIVITY...  SLACK ACTIVITY  ..LOWER LIMIT.  ..UPPER LIMIT.  .DUAL ACTIVITY    ..I
    998  OBJ       BS      36394.79800    -36394.79800            NONE            NONE         1.00000      1
    999  ACTEQ     EQ          1.00000         0.0             1.00000         1.00000     -5341.86792      2
   1010  DPCSTUSL  BS       -103.61000       103.61000            NONE            0.0            0.0      13
   1018  FMFXEXP   EQ          1.00000         0.0             1.00000         1.00000     25716.30094     21
   1020  F4AC      UL         75.00000         0.0                NONE        75.00000       -59.81737     23
   1045  F4EROS    BS        750.75002      4249.24998            NONE      5000.00000            0.0      48
   1046  F4USLE    BS        293.24999      4706.75001            NONE      5000.00000            0.0      49
   1047  F8AC      UL         36.00000         0.0                NONE        36.00000       -42.04834     50
   1056  F8EROS    BS        169.19999      4830.80001            NONE      5000.00000            0.0      59
   1065  F8USLE    BS         90.72002      4909.27998            NONE      5000.00000            0.0      68
   1066  HRAC      UL        160.00000         0.0                NONE       160.00000       -45.38026     69
   1091  HREROS    BS        907.69996      4092.30004            NONE      5000.00000            0.0      94
   1092  HRUSLE    BS        857.29997      4142.70003            NONE      5000.00000            0.0      95
   1093  LAC       UL        200.00000         0.0                NONE       200.00000       -21.24571     96
   1110  LEROS     BS        493.34994      4506.65006            NONE      5000.00000            0.0     113
   1111  LUSLE     BS        493.34994      4506.65006            NONE      5000.00000            0.0     114
   1112  MAXCNAC   UL        441.00000         0.0                NONE       441.00000       -68.64653     115
   1114  MINBNAC   BS        168.00000       -38.00000        130.00000            NONE         0.0      117
   1115  MINCNAC   BS        441.00000      -441.00000            0.0            NONE         0.0      118
   1116  MXCRPPAY  BS      33141.00134     16858.99866            NONE     50000.00000         0.0      119
   1119  OFFINC    EQ          1.00000         0.0             1.00000         1.00000     -305.75472     122
   1120  ORAC      UL        110.00000         0.0                NONE       110.00000       -40.65327     123
   1141  OREROS    BS       1292.50000      3707.50000            NONE      5000.00000            0.0     144
   1142  ORUSLE    BS        258.50004      4741.49996            NONE      5000.00000            0.0     145
   1144  O4AC      UL         70.00000         0.0                NONE        70.00000       -54.34468     147
   1165  O4EROS    BS        603.39999      4396.60001            NONE      5000.00000            0.0     168
   1166  O4USLE    BS        232.39998      4767.60002            NONE      5000.00000            0.0     169
   1167  O8AC      UL         49.00000         0.0                NONE        49.00000        -2.20434     170
   1176  O8EROS    BS         49.00000      4951.00000            NONE      5000.00000            0.0     179
   1185  O8USLE    BS         49.00000      4951.00000            NONE      5000.00000            0.0     188
   1186  PPTILAC   BS        300.00000      -300.00000             0.0            NONE         0.0      189
\
]%(#
   1189  SETCNAC   EQ         49.00000         0.0            49.00000        49.00000         5.78779     192
   1190  SETWTAC   EQ         15.00000         0.0            15.00000        15.00000         1.71409     193
   1200  ZTILAC    BS        336.00000      -336.00000             0.0            NONE         0.0      203
   1202  10091022  UL        193.00000         0.0                NONE       193.00000        -3.13804     205
   1203  10231105  BS        165.55200        17.84799            NONE       183.39999         0.00000     206
   1204  11061112  BS         68.76700         6.83300            NONE        75.60001         0.0      207
   1206  319423    BS         51.15600        59.94401            NONE       111.10001         0.0      209
   1207  424430    BS         28.97400        38.22600            NONE        67.20000         0.0      210
   1208  501514    BS        139.98600        69.41399            NONE       209.39999         0.0      211
   1209  515521    BS         43.64250        52.95751            NONE        96.60001         0.0      212
   1210  522528    BS         24.24750        90.75250            NONE       115.00000         0.0      213
   1211  529604    BS         22.60500        53.59499            NONE        76.20000         0.0      214
   1212  605625    BS        108.70500       122.89500            NONE       231.60001         0.0      215
   1213  710716    BS          7.69500        90.90501            NONE        98.60001         0.0      216
   1216  807820    BS          3.45000       185.94999            NONE       189.39999         0.0      219
   1217  821903    BS         15.36750       160.43250            NONE       175.80000         0.0      220
   1219  9251008   BS         55.46600       119.73400            NONE       175.20000         0.0      222
0
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SECTION 2 - COLUMNS

NUMBER	.COLUMN.	AT	...ACTIVITY...	.OBJ GRADIENT.	..LOWER LIMIT.	..UPPER LIMIT.	.REDUCED COST.	M+J
13	A15111	BS	110.00000	0.0	0.0	NONE	0.0	235
163	B15111	BS	70.00000	0.0	0.0	NONE	0.0	385
355	C36111	BS	92.50000	0.0	0.0	NONE	0.0	577
358	C36121	BS	70.46316	0.0	0.0	NONE	0.0	580
359	C36122	BS	22.03684	0.0	0.0	NONE	0.0	581
415	D15111	BS	75.00000	0.0	0.0	NONE	0.0	637
595	E15111	BS	9.00000	0.0	0.0	NONE	0.0	817
739	E36111	BS	75.50000	0.0	0.0	NONE	0.0	961
742	E36121	BS	75.50000	0.0	0.0	NONE	0.0	964
835	F55111	BS	9.00000	0.0	0.0	NONE	0.0	1057
840	F55143	BS	4.50000	0.0	0.0	NONE	0.0	1062
841	F55171	BS	22.50000	0.0	0.0	NONE	0.0	1063
949	ALSAL	BS	90.00000	0.0	0.0	NONE	0.0	1171
950	BNSAL	BS	6358.43934	0.0	0.0	NONE	0.0	1172
951	CNSAL	BS	67862.50000	0.0	0.0	NONE	0.0	1173
952	DFPAYCN	BS	67862.50000	0.0	0.0	NONE	0.0	1174
954	DFBENTOT	BS	77.00003	0.0	0.0	NONE	0.0	1176
955	DFCSTTOT	BS	334.06998	0.0	0.0	NONE	0.0	1177
964	FMEROS	BS	4271.89989	0.0	0.0	NONE	0.0	1186
965	FMFXEXP	BS	1.00000	0.0	0.0	NONE	0.0	1187
966	FMUSLE	BS	2274.51993	0.0	0.0	NONE	0.0	1188
967	OFFINC	BS	1.00000	0.0	0.0	NONE	0.0	1189
968	OTSAL	BS	306.00000	0.0	0.0	NONE	0.0	1190
971	SETCNAC	BS	49.00000	0.0	0.0	NONE	0.0	1193
972	SETWTAC	BS	15.00000	0.0	0.0	NONE	0.0	1194
974	STFDTX10	BS	0.14721	0.0	0.0	NONE	0.0	1196
975	STFDTX11	BS	0.85279	0.0	0.0	NONE	0.0	1197
989	TRANCSH	BS	36394.79800	1.00000	0.0	NONE	0.0	1211
997	BVEC	EQ	-1.00000	0.0	-1.00000	-1.00000	-36394.79800	1219

0

TOTAL ACRES BY ROTATION FOR ROTATION	1	=	264.00
TOTAL ACRES BY ROTATION FOR ROTATION	2	=	0.0
TOTAL ACRES BY ROTATION FOR ROTATION	3	=	336.00
TOTAL ACRES BY ROTATION FOR ROTATION	4	=	0.0
TOTAL ACRES BY ROTATION FOR ROTATION	5	=	36.00
TOTAL ACRES BY TILLAGE FOR TILLAGE	1	=	0.0
TOTAL ACRES BY TILLAGE FOR TILLAGE	2	=	0.0
TOTAL ACRES BY TILLAGE FOR TILLAGE	5	=	300.00
TOTAL ACRES BY TILLAGE FOR TILLAGE	6	=	336.00
TOTAL ACRES BY TILLAGE FOR TILLAGE	7	=	0.0
TOTAL ACRES BY PRACTICE FOR PRACTICE	1	=	636.00
TOTAL ACRES BY PRACTICE FOR PRACTICE	2	=	0.0
TOTAL ACRES BY PRACTICE FOR PRACTICE	3	=	0.0
TOTAL ACRES BY PRACTICE FOR PRACTICE	6	=	0.0
TOTAL ACRES BY CROP FOR CROP	1	=	441.00
TOTAL ACRES BY CROP FOR CROP	2	=	168.00
TOTAL ACRES BY CROP FOR CROP	3	=	0.0
TOTAL ACRES BY CROP FOR CROP	4	=	4.50
TOTAL ACRES BY CROP FOR CROP	7	=	22.50
TOTAL ACRES BY PERIOD FOR PERIOD	1	=	609.46
TOTAL ACRES BY PERIOD FOR PERIOD	2	=	22.04
TOTAL ACRES BY PERIOD FOR PERIOD	3	=	4.50
0 LABOR TOTAL		=	928.61
TOTAL ACRES		=	636.00

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BRANCH COUNTY - REPRESENTATIVE FARM 4/16/85
EXAMPLE OF AVERAGE YEARLY BUDGET FOR THREE SOIL PRODUCTIVITY GROUPS
CORN CONVENTIONAL

I N P U T S						UNIT PRICE	COST FOR	Y I E L D	L E V E L S
ITEM		75.0	110.0	130.0	BU/ACRE		75.0 BU	110.0 BU	130.0 BU
SEED		12.00	13.00	14.00	LB/ACRE	1.20	14.40	15.60	16.80
FERTILIZERS AND CHEMICALS									
NITROGEN	NITROGEN	25.0	25.0	25.0	LB/ACRE	0.27	6.75	6.75	6.75
NITROGEN	ANHYDROUS	61.1	114.3	144.7	LB/ACRE	0.16	9.77	18.28	23.14
PHOSPHORUS	PHOSPHATE	25.0	25.0	25.0	LB/ACRE	0.25	6.25	6.25	6.25
POTASSIUM	POTASH	50.0	81.8	100.0	LB/ACRE	0.12	6.00	9.82	12.00
HERBICIDE	ATRAZINE	1.5	1.5	1.5	LB/ACRE	2.00	3.00	3.00	3.00
HERBICIDE	LASSO	2.0	2.0	2.0	LB/ACRE	4.11	8.22	8.22	8.22
HERBICIDE	FURADAN	10.0	10.0	10.0	LB/ACRE	1.00	10.00	10.00	10.00
LIME		0.4	0.4	0.4	TONS/ACRE	15.00	5.62	5.62	5.62
INTEREST ON OPERATING CAPITAL FOR 12. MONTHS						13.00 PERCENT	9.10	10.86	11.93
SUBTOTAL							79.12	94.41	103.72
FIELD OPERATIONS (MACHINERY ADJUSTMENT FACTOR OF 1.00)									
40 FT FERT SPREAD		0.08	0.08	0.08	HOURS/ACRE	0.00	0.00	0.00	0.00
8 FT MBD PLOW		0.29	0.29	0.29	HOURS/ACRE	12.07	3.46	3.46	3.46
18 FT TDM DISK		0.13	0.13	0.13	HOURS/ACRE	10.68	1.36	1.36	1.36
7 SHANK ANHY APPLICATOR		0.18	0.18	0.18	HOURS/ACRE	0.00	0.00	0.00	0.00
15 FT PLANTER W FERT		0.18	0.18	0.18	HOURS/ACRE	23.36	4.26	4.26	4.26
30 FT SPRAYER		0.07	0.07	0.07	HOURS/ACRE	7.45	0.53	0.53	0.53
15 FT SWEEDISH CULT		0.21	0.21	0.21	HOURS/ACRE	3.14	0.67	0.67	0.67
15 FT CORN HEAD		0.26	0.28	0.30	HOURS/ACRE	0.00	0.00	0.00	0.00
GRAIN WAGON		0.12	0.13	0.14	HOURS/ACRE	4.71	0.59	0.63	0.68
70 HP TRACTOR		0.85	0.85	0.86	HOURS/ACRE	11.20	9.47	9.57	9.68
135 HP TRACTOR		0.41	0.41	0.41	HOURS/ACRE	20.94	8.66	8.66	8.66
3/4 TON PICKUP		0.60	0.60	0.60	HOURS/ACRE	8.15	4.89	4.89	4.89
2 TON TRUCK		0.30	0.30	0.30	HOURS/ACRE	20.36	6.11	6.11	6.11
6 ROW SP COMBINE CORN		0.26	0.28	0.30	HOURS/ACRE	108.95	28.53	30.63	32.72
CUSTOM MACHINERY AND LABOR COSTS							0.50	0.50	0.50
HAULING AND DRYING CHARGES						0.18	13.50	19.80	23.40
LABOR		2.91	2.94	2.97	HOURS/ACRE	3.88	11.27	11.41	11.54
SUBTOTAL							93.81	102.48	108.45
TOTAL PER ACRE PRODUCTION COST							172.93	196.89	212.17
TOTAL PER ACRE VALUE							189.75	278.30	328.90
RETURN PER ACRE OVER PRODUCTION COST							16.82	81.41	116.73
TOTAL PER ACRE COST							172.93	196.89	212.17
TOTAL PER ACRE VALUE							189.75	278.30	328.90
TOTAL RETURN PER ACRE							16.82	81.41	116.73
COST PER BU							2.31	1.79	1.63
VALUE PER BU							2.53	2.53	2.53
GASOLINE		2.70	2.70	2.70	GALS./ACRE	1.25	3.37	3.37	3.37
DIESEL		7.09	7.23	7.38	GALS./ACRE	1.06	7.51	7.67	7.82

4/16/85

BRANCH COUNTY - REPRESENTATIVE FARM
EXAMPLE OF AVERAGE YEARLY BUDGET FOR THREE SOIL PRODUCTIVITY GROUPS
CORN CHISEL TILL

	I N P U T S				UNIT PRICE	COST FOR	Y I E L D	L E V E L S
ITEM	75.0	110.0	130.0	BU/ACRE		75.0 BU	110.0 BU	130.0 BU
SEED	12.00	13.00	14.00	LB/ACRE	1.20	14.40	15.60	16.80
FERTILIZERS AND CHEMICALS								
NITROGEN NITROGEN	25.0	25.0	25.0	LB/ACRE	0.27	6.75	6.75	6.75
NITROGEN ANHYDROUS	61.1	114.3	144.7	LB/ACRE	0.16	9.77	18.28	23.14
PHOSPHORUS PHOSPHATE	25.0	25.0	25.0	LB/ACRE	0.25	6.25	6.25	6.25
POTASSIUM POTASH	50.0	81.8	100.0	LB/ACRE	0.12	6.00	9.82	12.00
HERBICIDE ATRAZINE	1.5	1.5	1.5	LB/ACRE	2.00	3.00	3.00	3.00
HERBICIDE LASSO	2.0	2.0	2.0	LB/ACRE	4.11	8.22	8.22	8.22
HERBICIDE FURADAN	10.0	10.0	10.0	LB/ACRE	1.00	10.00	10.00	10.00
LIME	0.4	0.4	0.4	TONS/ACRE	15.00	5.62	5.62	5.62
INTEREST ON OPERATING CAPITAL FOR 12. MONTHS				13.00 PERCENT		9.10	10.86	11.93
SUBTOTAL						79.12	94.41	103.72
FIELD OPERATIONS (MACHINERY ADJUSTMENT FACTOR OF 1.00)								
40 FT FERT SPREAD	0.08	0.08	0.08	HOURS/ACRE	0.00	0.00	0.00	0.00
11 FT CHISEL PLOW	0.21	0.21	0.21	HOURS/ACRE	3.52	0.73	0.73	0.73
18 FT TDM DISK	0.13	0.13	0.13	HOURS/ACRE	10.68	1.36	1.36	1.36
7 SHANK ANHY APPLICATOR	0.18	0.18	0.18	HOURS/ACRE	0.00	0.00	0.00	0.00
15 FT PLANTER W FERT	0.18	0.18	0.18	HOURS/ACRE	23.36	4.26	4.26	4.26
30 FT SPRAYER	0.07	0.07	0.07	HOURS/ACRE	7.45	0.53	0.53	0.53
15 FT SWEEDISH CULT	0.21	0.21	0.21	HOURS/ACRE	3.14	0.67	0.67	0.67
15 FT CORN HEAD	0.26	0.28	0.30	HOURS/ACRE	0.00	0.00	0.00	0.00
GRAIN WAGON	0.12	0.13	0.14	HOURS/ACRE	4.71	0.59	0.63	0.68
70 HP TRACTOR	0.85	0.85	0.86	HOURS/ACRE	11.20	9.47	9.57	9.68
135 HP TRACTOR	0.34	0.34	0.34	HOURS/ACRE	20.94	7.03	7.03	7.03
3/4 TON PICKUP	0.60	0.60	0.60	HOURS/ACRE	8.15	4.89	4.89	4.89
2 TON TRUCK	0.30	0.30	0.30	HOURS/ACRE	20.36	6.11	6.11	6.11
6 ROW SP COMBINE CORN	0.26	0.28	0.30	HOURS/ACRE	108.95	28.53	30.63	32.72
CUSTOM MACHINERY AND LABOR COSTS						0.50	0.50	0.50
HAULING AND DRYING CHARGES					0.18	13.50	19.80	23.40
LABOR	2.81	2.85	2.88	HOURS/ACRE	3.88	10.91	11.04	11.17
SUBTOTAL						89.09	97.76	103.73
TOTAL PER ACRE PRODUCTION COST						168.21	192.16	207.45
TOTAL PER ACRE VALUE						139.75	278.30	328.90
RETURN PER ACRE OVER PRODUCTION COST						21.54	86.14	121.45
TOTAL PER ACRE COST						168.21	192.16	207.45
TOTAL PER ACRE VALUE						189.75	278.30	328.90
TOTAL RETURN PER ACRE						21.54	86.14	121.45
COST PER BU						2.24	1.75	1.60
VALUE PER BU						2.53	2.53	2.53
GASOLINE	2.70	2.70	2.70	GALS./ACRE	1.25	3.37	3.37	3.37
DIESEL	6.58	6.72	6.87	GALS./ACRE	1.06	6.97	7.13	7.28

BRANCH COUNTY - REPRESENTATIVE FARM 4/16/85

EXAMPLE OF AVERAGE YEARLY BUDGET FOR THREE SOIL PRODUCTIVITY GROUPS

CORN PLOW PLANT

I N P U T S					UNIT PRICE		COST FOR YIELD LEVELS		
ITEM		75.0	110.0	130.0	BU/ACRE		75.0 BU	110.0 BU	130.0 BU
SEED		12.00	13.00	14.00	LB/ACRE	1.20	14.40	15.60	16.80
FERTILIZERS AND CHEMICALS									
NITROGEN	NITROGEN	25.0	25.0	25.0	LB/ACRE	0.27	6.75	6.75	6.75
NITROGEN	ANHYDROUS	61.1	114.3	144.7	LB/ACRE	0.16	9.77	18.28	23.14
PHOSPHORUS	PHOSPHATE	25.0	25.0	25.0	LB/ACRE	0.25	6.25	6.25	6.25
POTASSIUM	POTASH	50.0	81.8	100.0	LB/ACRE	0.12	6.00	9.82	12.00
HERBICIDE	ATRAZINE	1.5	1.5	1.5	LB/ACRE	2.00	3.00	3.00	3.00
HERBICIDE	LASSO	2.0	2.0	2.0	LB/ACRE	4.11	8.22	8.22	8.22
HERBICIDE	FURADAN	10.0	10.0	10.0	LB/ACRE	1.00	10.00	10.00	10.00
LIME		0.4	0.4	0.4	TONS/ACRE	15.00	5.62	5.62	5.62
INTEREST ON OPERATING CAPITAL FOR 12. MONTHS					13.00 PERCENT		9.10	10.86	11.93
SUBTOTAL							79.12	94.41	103.72
FIELD OPERATIONS (MACHINERY ADJUSTMENT FACTOR OF 1.00)									
40 FT FERT SPREAD		0.08	0.08	0.08	HOURS/ACRE	0.00	0.00	0.00	0.00
8 FT MBD PLOW		0.29	0.29	0.29	HOURS/ACRE	12.07	3.46	3.46	3.46
15 FT PLANTER W FERT		0.18	0.18	0.18	HOURS/ACRE	23.36	4.26	4.26	4.26
30 FT SPRAYER		0.07	0.07	0.07	HOURS/ACRE	7.45	0.53	0.53	0.53
7 SHANK ANHY APPLICATOR		0.18	0.18	0.18	HOURS/ACRE	0.00	0.00	0.00	0.00
15 FT CORN HEAD		0.26	0.28	0.30	HOURS/ACRE	0.00	0.00	0.00	0.00
GRAIN WAGON		0.12	0.13	0.14	HOURS/ACRE	4.71	0.59	0.63	0.68
70 HP TRACTOR		0.63	0.64	0.65	HOURS/ACRE	11.20	7.06	7.17	7.27
135 HP TRACTOR		0.29	0.29	0.29	HOURS/ACRE	20.94	6.00	6.00	6.00
3/4 TON PICKUP		0.60	0.60	0.60	HOURS/ACRE	8.15	4.89	4.89	4.89
2 TON TRUCK		0.30	0.30	0.30	HOURS/ACRE	20.36	6.11	6.11	6.11
6 ROW SP COMBINE CORN		0.26	0.28	0.30	HOURS/ACRE	108.95	28.53	30.63	32.72
CUSTOM MACHINERY AND LABOR COSTS							0.50	0.50	0.50
HAULING AND DRYING CHARGES						0.18	13.50	19.80	23.40
LABOR		2.49	2.53	2.56	HOURS/ACRE	3.88	9.68	9.81	9.94
SUBTOTAL							85.11	93.78	99.75
TOTAL PER ACRE PRODUCTION COST							164.23	188.19	203.47
TOTAL PER ACRE VALUE							189.75	278.30	328.90
RETURN PER ACRE OVER PRODUCTION COST							25.52	90.11	125.43
TOTAL PER ACRE COST							164.23	188.19	203.47
TOTAL PER ACRE VALUE							189.75	278.30	328.90
TOTAL RETURN PER ACRE							25.52	90.11	125.43
COST PER BU							2.19	1.71	1.57
VALUE PER BU							2.53	2.53	2.53
GASOLINE		2.70	2.70	2.70	GALS./ACRE	1.25	3.37	3.37	3.37
DIESEL		5.54	5.68	5.83	GALS./ACRE	1.06	5.87	6.02	6.18

4/16/85

BRANCH COUNTY - REPRESENTATIVE FARM
EXAMPLE OF AVERAGE YEARLY BUDGET FOR THREE SOIL PRODUCTIVITY GROUPS
CORN NO TILLAGE

I N P U T S						UNIT PRICE	COST FOR Y I E L D L E V E L S		
ITEM		75.0	110.0	130.0	BU/ACRE		75.0 BU	110.0 BU	130.0 BU
SEED		12.00	13.00	14.00	LB/ACRE	1.20	14.40	15.60	16.80
FERTILIZERS AND CHEMICALS									
NITROGEN	NITROGEN	25.0	25.0	25.0	LB/ACRE	0.27	6.75	6.75	6.75
NITROGEN	ANHYDROUS	61.1	114.3	144.7	LB/ACRE	0.16	9.77	18.28	23.14
PHOSPHORUS	PHOSPHATE	25.0	25.0	25.0	LB/ACRE	0.25	6.25	6.25	6.25
POTASSIUM	POTASH	50.0	81.8	100.0	LB/ACRE	0.12	6.00	9.82	12.00
HERBICIDE	ATRAZINE	1.5	1.5	1.5	LB/ACRE	2.00	3.00	3.00	3.00
HERBICIDE	FURADAN	10.0	10.0	10.0	LB/ACRE	1.00	10.00	10.00	10.00
HERBICIDE	DUAL	2.0	2.0	2.0	LB/ACRE	4.11	8.22	8.22	8.22
HERBICIDE	PARAQUAT	2.0	2.0	2.0	PT/ACRE	4.75	9.50	9.50	9.50
LIME		0.4	0.4	0.4	TONS/ACRE	15.00	5.62	5.62	5.62
INTEREST ON OPERATING CAPITAL FOR 12. MONTHS						13.00 PERCENT	10.34	12.10	13.17
SUBTOTAL							89.86	105.14	114.46
FIELD OPERATIONS (MACHINERY ADJUSTMENT FACTOR OF 1.00)									
40 FT FERT SPREAD		0.08	0.08	0.08	HOURS/ACRE	0.00	0.00	0.00	0.00
7 SHANK ANHY APPLICATOR		0.18	0.18	0.18	HOURS/ACRE	0.00	0.00	0.00	0.00
15 FT MINTIL W FERT		0.23	0.23	0.23	HOURS/ACRE	25.29	5.93	5.93	5.93
30 FT SPRAYER		0.07	0.07	0.07	HOURS/ACRE	7.45	0.53	0.53	0.53
15 FT CORN HEAD		0.26	0.28	0.30	HOURS/ACRE	0.00	0.00	0.00	0.00
GRAIN WAGON		0.12	0.13	0.14	HOURS/ACRE	4.71	0.59	0.63	0.68
30 FT SPRAYER		0.07	0.07	0.07	HOURS/ACRE	7.45	0.53	0.53	0.53
70 HP TRACTOR		0.75	0.76	0.77	HOURS/ACRE	11.20	8.44	8.54	8.64
3/4 TON PICKUP		0.60	0.60	0.60	HOURS/ACRE	8.15	4.89	4.89	4.89
2 TON TRUCK		0.30	0.30	0.30	HOURS/ACRE	20.36	6.11	6.11	6.11
6 ROW SP COMBINE CORN		0.26	0.28	0.30	HOURS/ACRE	108.95	28.53	30.63	32.72
CUSTOM MACHINERY AND LABOR COSTS							0.50	0.50	0.50
HAULING AND DRYING CHARGES						0.18	13.50	19.80	23.40
LABOR		2.30	2.33	2.37	HOURS/ACRE	3.88	8.92	9.05	9.18
SUBTOTAL							78.46	87.13	93.10
TOTAL PER ACRE PRODUCTION COST							168.32	192.27	207.56
TOTAL PER ACRE VALUE							189.75	278.30	328.90
RETURN PER ACRE OVER PRODUCTION COST							21.43	86.03	121.34
TOTAL PER ACRE COST							168.32	192.27	207.56
TOTAL PER ACRE VALUE							189.75	278.30	328.90
TOTAL RETURN PER ACRE							21.43	86.03	121.34
COST PER BU							2.24	1.75	1.60
VALUE PER BU							2.53	2.53	2.53
GASOLINE		2.70	2.70	2.70	GALS./ACRE	1.25	3.37	3.37	3.37
DIESEL		4.09	4.23	4.38	GALS./ACRE	1.06	4.33	4.49	4.64

TABLE 1 --CURRENT EROSION, COSTS, AND RETURNS BY SOIL FOR BRANCH COUNTY, ST. JOSEPH RIVER BASIN

SOIL: LOCKE, 1-4 PCT , R= 125., K= .20, L= 400., S= 4.0, LS= .696, T= 5.0

CLASS: 2W WIND LENGTH: 1683

IF DIVERSION, L= 200

DATE: 12/13/84

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ROTATION 1/	TILLAGE	PRACTICE	C	P	WATER EROSION	WIND EROSION	TOTAL EROSION	AVE ANNUAL VALUE OF PROD/ACRE	AVE ANNUAL PRODUCTION COST/ACRE -MGT-LAND	AVE ANNUAL NET RETURN PER ACRE TO MGT AND LAND	AVE ANNUAL NET RETURN W/PRACT 2/	CHANGE IN NET RETURN W/PRACT 2/
C-C-BR	CONVENTIONAL	NONE	.37	1.0	6.4	2.6	9.0	246.	173.	73.	73.	.00
C-C-BR	PLOW-PLANT	NONE	.30	1.0	5.2	2.6	7.8	255.	168.	87.	87.	14.29
C-C-BR	CHISEL 1000-2000	NONE	.30	1.0	5.2	.0	5.2	255.	170.	85.	85.	11.67
C-C-BR	CHISEL 2000-3000	NONE	.26	1.0	4.5	.0	4.5	255.	170.	85.	85.	11.67
C-C-BR	RIDGE 1000-2000	NONE	.30	1.0	5.2	.0	5.2	264.	168.	96.	96.	22.89
C-C-BR	RIDGE 2000-3000	NONE	.26	1.0	4.5	.0	4.5	264.	168.	96.	96.	22.89
C-C-BR	NO TIL 4000+	NONE	.12	1.0	2.1	.0	2.1	260.	167.	93.	93.	19.71
C-C-BR	CONVENTIONAL	WATERWAY	.37	1.0	6.4	2.6	9.0	243.	172.	70.	62.	-10.82
C-C-BR	PLOW-PLANT	WATERWAY	.30	1.0	5.2	2.6	7.8	252.	167.	85.	77.	3.40
C-C-BR	CHISEL 1000-2000	WATERWAY	.30	1.0	5.2	.0	5.2	252.	170.	82.	74.	.77
C-C-BR	CHISEL 2000-3000	WATERWAY	.26	1.0	4.5	.0	4.5	252.	170.	82.	74.	.77
C-C-BR	RIDGE 1000-2000	WATERWAY	.30	1.0	5.2	.0	5.2	261.	168.	93.	85.	11.93
C-C-BR	RIDGE 2000-3000	WATERWAY	.26	1.0	4.5	.0	4.5	261.	168.	93.	85.	11.93
C-C-BR	NO TIL 4000+	WATERWAY	.12	1.0	2.1	.0	2.1	257.	167.	90.	82.	8.83
C-C-BR	CONVENTIONAL	DIV W/CONT	.37	.5	2.4	2.6	5.0	245.	181.	64.	61.	-12.01
C-C-BR	PLOW-PLANT	DIV W/CONT	.30	.5	2.0	2.6	4.6	254.	176.	79.	76.	3.02
C-C-BR	CHISEL 1000-2000	DIV W/CONT	.30	.5	2.0	.0	2.0	254.	178.	76.	73.	.11
C-C-BR	CHISEL 2000-3000	DIV W/CONT	.26	.5	1.7	.0	1.7	254.	178.	76.	73.	.11
C-C-BR	RIDGE 1000-2000	DIV W/CONT	.30	.5	2.0	.0	2.0	264.	176.	88.	85.	11.92
C-C-BR	RIDGE 2000-3000	DIV W/CONT	.26	.5	1.7	.0	1.7	264.	176.	88.	85.	11.92
C-C-BR	NO TIL 4000+	DIV W/CONT	.12	.5	.8	.0	.8	259.	174.	85.	82.	9.24
C-C-BR	CONVENTIONAL	SEDIMENT BAS	.37	1.0	6.4	2.6	9.0	246.	173.	73.	59.	-14.15
C-C-BR	PLOW-PLANT	SEDIMENT BAS	.30	1.0	5.2	2.6	7.8	255.	168.	87.	73.	.14
C-C-BR	CHISEL 1000-2000	SEDIMENT BAS	.30	1.0	5.2	.0	5.2	255.	170.	85.	71.	-2.48
C-C-BR	CHISEL 2000-3000	SEDIMENT BAS	.26	1.0	4.5	.0	4.5	255.	170.	85.	71.	-2.48
C-C-BR	RIDGE 1000-2000	SEDIMENT BAS	.30	1.0	5.2	.0	5.2	264.	168.	96.	82.	8.74
C-C-BR	RIDGE 2000-3000	SEDIMENT BAS	.26	1.0	4.5	.0	4.5	264.	168.	96.	82.	8.74
C-C-BR	NO TIL 4000+	SEDIMENT BAS	.12	1.0	2.1	.0	2.1	260.	167.	93.	79.	5.56
C-C-C	CONVENTIONAL	NONE	.30	1.0	5.2	2.6	7.8	264.	186.	78.	78.	4.52
C-C-C	PLOW-PLANT	NONE	.21	1.0	3.7	2.6	6.3	278.	181.	97.	97.	23.64
C-C-C	CHISEL 1000-2000	NONE	.25	1.0	4.4	.0	4.4	278.	185.	93.	93.	19.66
C-C-C	CHISEL 2000-3000	NONE	.19	1.0	3.3	.0	3.3	278.	185.	93.	93.	19.66
C-C-C	RIDGE 1000-2000	NONE	.25	1.0	4.4	.0	4.4	292.	189.	103.	103.	29.36
C-C-C	RIDGE 2000-3000	NONE	.19	1.0	3.3	.0	3.3	292.	189.	103.	103.	29.36
C-C-C	NO TIL 4000+	NONE	.06	1.0	1.0	.0	1.0	292.	189.	103.	103.	29.97

1/ ROTATIONS - C=CORN FOR GRAIN, CS=CORNSILAGE, CI=CORN IRRIGATED, BR=SOYBEANS ROWS, W=WHEAT, WX=WHEAT WITH COVER CROP, O=OATS, A=ALFALFA BALED FOR HAY.

2/ NET RETURN INCLUDES THE ANNUAL AMORTIZED INSTALLATION COSTS AND THE ANNUAL COST OF OPERATION AND MAINTENANCE OF CONSERVATION PRACTICES.

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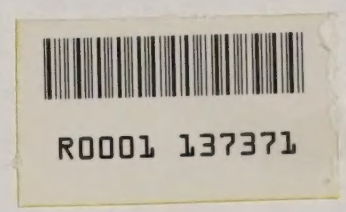
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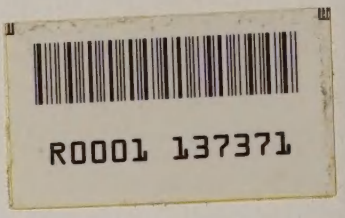
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